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Few Men Needed in Alaska

ATTENTION is called to the comments of the Secretary of the Interior on the chances for employment this year on the construction of the Alaska railroad, quoted in part on page 482. The work done this year will be largely of a preliminary nature. There are not sufficient funds available for extensive construction, and the conditions are so radically different from any encountered before that it would be unwise to undertake too much at first. Therefore, there will be employment for only a few, and these few are to be high-grade engineers. The Engineering Record has received numerous inquiries as to the opportunities for employment on the work, and there have been rumors of a stampede to Alaska. This would be the height of folly, because there is little other employment to be had, and the facilities for getting back to the United States in the fall are decidedly limited.

New York's Road Material Survey

THERE is more to New York State's survey of road-making materials, described on page 488, than the mere plotting of the locations of sand banks and rock ledges on topographic maps. Viewed in its larger aspects it is a move to co-ordinate the work of the testing laboratory and the field office to the end that definite information may be available not only as regards the position and quantity but also the quality of the State's highway construction resources. This can have but one result—improvement in the quality of road construction. New York State's highway system covers such a great area that in the construction of roads, especially in the sections distant from the large cities, dependence must be placed to a large extent on the materials which are available near at hand. There arises, therefore, an important economic problem in the selection of the type of pavement to be specified. In some places, for example, where the highway commission wishes to construct a concrete road, a reference to the permanent records of the survey may show that no local concrete materials of acceptable quality are to be had. Thus the survey data form a useful basis in reaching a quick decision as to the character of construction to be specified. Especially in concrete road construction have highway engineers come to realize the importance of sand of suitable quality. It is practically impossible to pass judgment on sand by a mere visual inspection. Compressive tests of concrete cubes, however, are a reliable criterion. It is in this phase of the work that the testing

laboratory at Albany and the field offices can do effective team-work. Even experienced men have been known to select as a suitable sand for road work material in which the grains are coated with a mineral or clay covering, impossible of detection by the eye, but which, nevertheless, produces a concrete of inferior quality. The usefulness of the survey records extend beyond the preliminaries and the award of a contract, for they are valuable also in connection with maintenance work. The road-material survey, therefore, is well worth while, and deserves the time being given it by various highway departments.

Restoration of Edison Buildings

SINCE early in December the Edison plant at West Orange, N. J., has rightfully occupied a most prominent place in the eyes of the engineering world. Tried by a test of the utmost severity, the concrete buildings came through in remarkably good condition, although not without severe local damage. To throw the behavior of the structures into proper perspective a few of the outstanding facts may be briefly rehearsed. There was no collapse except of two floors at the end of one building; in one place, though wall columns failed so that the span between sound supports was 75 ft., the integrity of the four-storied structure above was not affected; in another case there was a similar span, safely carried, with two floors above, while in a third there was a drop of 14 in. at a failed column without collapse of the structure. As a result of this toughness of the frame, which seems hardly possible of duplication in any other structural material, the salvage of non-burnable contents in the concrete buildings was very high, running, for the machinery, about 98 per cent. Striking as this experience was, it is questionable whether the concluding chapter, the repair work, is not of even greater engineering interest. To comprehend clearly the character of the destruction, the reader should refer to the article in the Engineering Record of Dec. 19, 1914, which showed clearly the effects of the fire on the concrete members. On page 503 of this issue will be found a complete account of the restoration work. In every case, except where total collapse occurred in one corner, damaged members have been repaired and—most remarkable of all—members badly deflected through failure of their supporting columns have been jacked back to place and restored. While every precaution should be taken not to subject any structure to a repetition of such a severe fire test, there is an added feeling of confidence in concrete from knowing what it can endure

and to what extent repairs are possible. The fire taught much as to details of construction, and should result in improvement in minor respects. Of course, the overshadowing lesson was—and its importance is so great as to bear repetition—that a non-burnable frame does not make a fireproof structure. Fire-protected door and window openings, fire walls and automatic sprinklers are needed even though the frames cannot be consumed by fire.

The Reward of Carefulness

IN NO FORM of construction more than in the building of a concrete road does strict attention to details bring a greater reward. In fact, it is the seemingly minor features of the day's work which must be handled with painstaking care if the pavement is to stand the test of time. Insistence on the use of accurately calibrated boxes for measuring concrete aggregate instead of ordinary wheelbarrows, a minimum mixing period of 1½ min. for each batch of concrete, the washing of all sand used, the placing of plenty of coarse aggregate near joints to prevent wear, the substitution of an 18-in. gravel base for an old macadam foundation—these are a few of the construction details to which the State Highway Department of Connecticut attributes the excellent condition of the Milford Turnpike described on page 480. The fact that only one fine crack has developed in a pavement 4¼ miles long after almost a year's service is an evidence of the quality of the work. It should be noted, however, that the concrete is reinforced with wire mesh and that tar-paper expansion joints occur every 30 ft.—two features which would naturally prevent temperature stresses from making themselves manifest. When the work was begun last summer the aim was to produce a model piece of construction. The results of an inspection of the surface after a year's use justify the belief that this result has been accomplished.

Traction Trusses

A COMPARATIVELY recent development in structural design is the use of traction trusses or girders in modern long-span bridges. The article by C. A. Norton, on page 492 of this issue, describes the general types of trusses used in the new Quebec bridge to solve the problem of adequate provision for the transfer of longitudinal forces to the main trusses and bracing. The location of the expansion joints in the floor system and the selection of the best position for these traction trusses are points in the design of such long structures which require careful con-

sideration. This problem of proper provision for traction stresses has been met in a somewhat similar way by Mr. Lindenthal in the design of the new Hell Gate arch now being erected over the East River. In the Engineering Record of Sept. 12, 1914, page 298, will be found a general description of the horizontal plate girders used at the two points of this bridge where the floor intersects the curving lower chord of the arch. It is evident that these girders serve a purpose similar to that of truss 1 in the Quebec bridge, in transferring the longitudinal traction forces to the main trusses. A notable difference in the construction, however, is found in the use of a horizontal traction girder for the Hell Gate arch, and of a diagonal traction truss, which induces bending in the main track girders, in the case of the Quebec bridge. It is evident that such problems are of a special nature and must be solved according to the particular requirements for detailing the connections to the main trusses and bracing in each type of bridge. This is pointedly shown by the fact that the new long-span bridge over the Ohio River at Sciotoville will contain horizontal traction girders at each panel point, thus distributing the longitudinal forces to the main trusses at points about 38 ft. apart, and avoiding large local concentrations.

Royal Commission on Sewage Disposal Submits Final Report

IN submitting its ninth and final reports early this month the Royal Commission on Sewage Disposal, of Great Britain, has brought to a conclusion an inquiry which has extended over a period of sixteen years. The ninth report deals with two general subjects—the discharge of manufacturing wastes which for any reason can not be taken into sewers and the discharge of domestic refuse in rural areas. The final report, issued simultaneously with the ninth report, is a recapitulation of the commission's main conclusions which have already been published. Of the nine reports issued four deal mainly with the purification of domestic sewage discharging into streams, two with the discharge of sewage into tidal waters, and three with the discharge of manufacturing effluents. Of the relative value of the many ramifications of the commission's work it is difficult to judge, but undoubtedly one of the outstanding features was the adoption in the eighth report (see Engineering Record, Dec. 28, 1912, page 711) of a general standard for effluents discharging into streams. This standard was based upon the assumption that no nuisance will be created if stream water normally takes up no more than 0.4 part per 100,000 dissolved oxygen in five days. For the treatment of trade wastes, dealt with in the ninth report, there are prescribed standards of purity which should be a guide to administrative authorities and a security to manufacturers in regard to the extent of their obligations. It remains now to put into effect laws embodying the commission's recommendations. As the "Surveyor" points out in discussing the report, if action is not taken immediately the amount of

work in Parliament after the war will probably be so great that the question of rivers protection and sewage disposal will be side-tracked for many years.

An Experiment in Instruction

BEGINNING with the second semester this year the Massachusetts Institute of Technology started, as an auxiliary measure, a promising scheme of individual instruction. The increasing number of students has in most schools outstripped the increase in the number of instructors to such a point that the classes themselves, while possibly not unwieldy, certainly do not allow that individual attention which was so prominent in the earlier days of our technical schools. Even if the sections be small an instructor who has, instead of three large ones, six small ones would be seriously overburdened by trying to give attention to his students outside of the class hours. It is true that in order to get at the individual pupil effectively small sections are necessary. This is especially the case in mathematics, and one of the reasons why the instruction in that subject at the United States Military Academy is so thorough and effective is because the cadets are taught in very small groups. The Massachusetts Institute of Technology has an exceptionally high ratio of instructors to students, but this merely signifies that there is an immense amount of instructional work in a very great variety of courses, and does not imply that instruction can be individualized sufficiently to get results which will satisfy a conscientious instructor.

The new scheme had its origin in the interest of the alumni and is the good work of the Technology Club of Rochester, N. Y. The scheme is to have available at a certain hour and place advisers to discuss personally with the students the particular things which puzzle them. Instructors for this work have been chosen not only on account of their capacity as teachers, but for their ability to meet the students in a real spirit of fellowship so as the more effectively to help them over the difficult places. It is, in a measure, a modification of the tutorial system, but with this difference—the aid given to the student is in addition to his ordinary courses of instruction, to fill up the gaps, as it were, that are left in instructing students in too large groups.

It may be objected that such advice outside of class hours is not part of the function of the professor giving the course. There is truth in the objection, but the two chief difficulties are these: The professor may clear up only a part of the problem, and the student may be diffident about asking him the same question over again. Secondly, the professor in his consultation period may be surrounded with so many questioners that he cannot give adequate attention to each. So far four of the younger men of the instructing staff are meeting the students, and in order that the best results may be secured the conferences are of the most informal character, resembling rather meetings between fellow students than between teacher and pupil.

If the students will avail themselves of

the opportunity thus offered the scheme should be of great assistance. One is inclined to think that the experiment would work best on a somewhat larger scale, so that it would be an entirely usual and inconspicuous thing for the student thus to seek aid in his difficulty. However, even on the very modest scale now undertaken it is a useful experiment in education.

A Bitter Lesson in Government Railroad Building

THE OPERATION by the Canadian Government of the National Transcontinental Railway, extending from Winnipeg, Man., on the West, to Moncton, N. B., on the East, 1805 miles, is very probable by reason of the refusal of the Grand Trunk Railway to carry out its agreement with the Government, under which the latter was to construct the line and upon its completion lease it to the Grand Trunk for fifty years, the first seven years to be free from rental or interest charge. During the remaining period the railroad company was to pay as rental 3½ per cent on the cost, the Grand Trunk to provide the equipment.

The road was planned by the Liberal Government and work started in 1906. The Government states that the road is now completed and has called upon the Grand Trunk to carry out its agreement, equip the line and begin operation. The Grand Trunk, however, claims that the road is not completed, the terminals at Quebec not being finished, and that certain grades which were originally designed as momentum grades and subsequently ordered revised are not ready, and, furthermore, that the cost of the road has been excessive. The last statement the Government denies. The result, however, will likely be that the Government will be obliged to equip and operate the line in order to provide transportation facilities to such settlers as have located in the territory traversed.

After the present Conservative Government came into power, it repudiated all responsibility for the results dependent upon the construction of the railway and appointed a commission to investigate the entire question—the character, cost and economical value of the road. This commission rendered an exhaustive report and stated, as one of its conclusions, that the line cost at least \$40,000,000 more than was necessary, which was at once seized upon by the Grand Trunk as one of its claims against carrying out its undertaking unless the figure on which the interest rental should be paid were reduced by the amount of the excess found by the commission.

The Liberal Government in proposing the building of the line stated that it would cost complete about \$30,000,000, which would average about \$17,000 per mile for the 1805 miles of road. The line has actually cost about \$180,000,000—an average of \$100,000 per mile or about six times the original estimated cost.

These facts are sufficient to indicate the economic waste which attends such projects when undertaken by a Government. The line extends for almost its entire length

through an unsettled country and for at least one-half the distance through a barren region, which will produce little local traffic. The line reaches no large traffic centers, excepting Winnipeg, and has no terminals excepting a joint one at Quebec with the Canadian Pacific Railway. Its revenue must be dependent almost wholly upon through traffic, which will consist principally of grain moving eastbound during the season of closed navigation, a period of about five months, and for this traffic it is in direct competition with two other Canadian transcontinental roads, the Canadian Pacific and the Canadian Northern. The boast was made by the Liberal Government, in placing the matter before the people, that grain would be handled by the Transcontinental from Winnipeg to Halifax for ten cents per bushel. This rate would yield the railway about $1\frac{1}{4}$ mills per ton mile, with an empty haul westbound. Such rates would not yield revenue sufficient to pay even operating expenses. Present operation of steam roads in sections of Ontario which are settled to a greater extent than the territory along the Transcontinental can expect in twenty-five years yield a gross revenue per mile of less than \$2000 per annum or scarcely sufficient to pay operating expenses.

The most serious aspect of the whole matter is the effect which the operation by the Government will have upon the lines of the Grand Trunk Pacific west of Winnipeg, which were built by the Grand Trunk under subsidies and guarantees by the Dominion and Provincial Governments. The main line extends from Winnipeg to Prince Rupert, on the Pacific Coast, and is now in operation, but is not earning sufficient to pay operating expenses. When the connection as a through transcontinental system is broken at Winnipeg naturally its traffic will be curtailed and the only solution would seem to be to have the Government take it over and operate a through transcontinental line from Halifax to Prince Rupert.

The effect which this will have upon the Canadian Pacific and Canadian Northern railways can be conjectured. The Government will not be required to pay any fixed charges and the clamor for cheap transportation will force all rates to such a point that the effect upon the two remaining transcontinentals cannot be anything but detrimental.

The Grand Trunk has likely been forced to its decision to give up the operation of the National Transcontinental by the present business conditions, by the small prospect of earning operating expenses during the first seven years of the lease, when no interest rental is due, and because, even then, it will be hopeless to expect to earn sufficient to pay the rental. The interest rental after seven years will be \$3500 per mile per annum, which, with operating expenses of \$2500, will require \$6000 per mile per annum, and this it cannot hope to earn during the next fifteen years.

The Government was perhaps justified in building its lines through the Provinces

of Quebec and Ontario to open up the country and develop their natural resources, but if it had been guided by business judgment and the best interests of the whole people it would have built lines at a cost not to exceed \$20,000 to \$25,000 per mile, which would have served the purpose equally as well as lines costing \$100,000 per mile. As the country grew the lines could have been developed with it, as was done with the through lines in the United States.

The railway situation which confronts the people of Canada is a most serious one and unless it be wisely administered it will have such a far reaching financial effect that the Dominion will not recover from in a generation. If the people of the United States desire to know what the results of Government ownership and operation mean in a practical way, let them give attention to the experience of their neighbor on the North. Governments should regulate railways along safe and reasonable lines, but it is not the function of government to carry out its own regulation at the expense of the people.

The Alaska Railroad

THE LONG-AWAITED announcement of the route for the first Government railroad in Alaska has been made. Seward is to be the starting point, and the privately owned Alaska Northern, running 71 miles to the north, is to be purchased as the first link of the main line, which will run up the Susitna valley and through Broad Pass to Fairbanks. About 400 miles of new construction will be required for the main line and the branch to the Matanuska coal fields will necessitate 38 miles additional. A map roughly showing the route, together with other pertinent information, will be found on page 482.

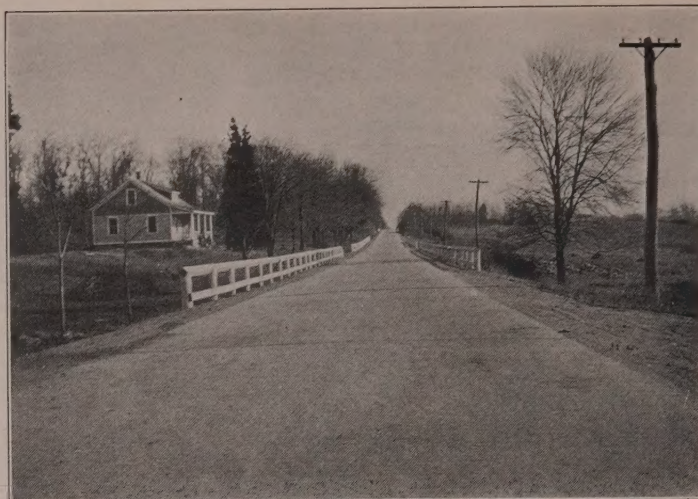
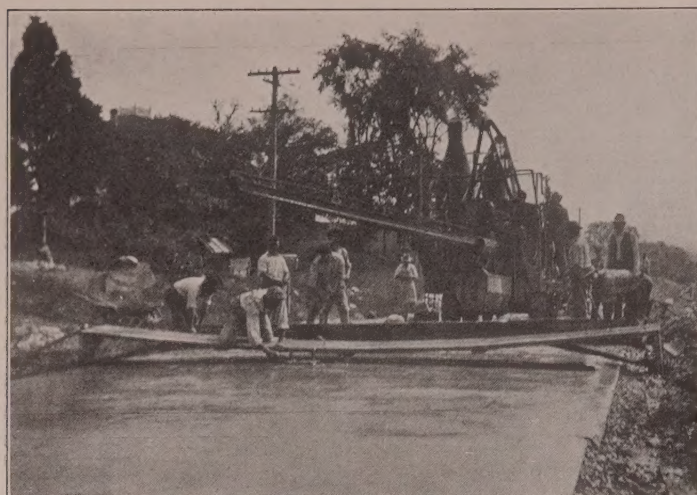
In reading the announcement one naturally compares the findings of the Alaskan Engineering Commission with those of its predecessor, the Alaska Railroad Commission, which were abstracted in the Engineering Record of March 21, 1914, page 332. The first point noticed is that the route selected is not one of those recommended by the first commission, but is an intermediate route investigated and rejected. The second is that of the four objectives—the Yukon River system, the Kuskokwim River, the Bering River coal fields and the Matanuska fields—of the first commission, only two, the first and the last, are reached by the route selected. The third is that the estimated cost of the work now proposed is about three-quarters of the amount figured by the first investigators for the entire project, that the estimated cost per mile is increased 25 per cent, and that there will not be enough left of the \$35,000,000 appropriated to do all that was desired.

More specifically, the original report recommended two independent systems, one from Cordova to the Bering River coal fields and to Fairbanks, on the Tanana River, a tributary of the Yukon, and the other from Seward to the Matanuska coal

fields and the Kuskokwim River. The latter route would be roughly parallel to the former, about 200 miles to the westward. Each would involve the acquisition of short existing roads. The new construction would amount to 733 miles, and cost \$35,611,000, fully equipped, or \$48,600 per mile. The estimated costs per mile of the individual lines ranged from \$42,500 to \$55,600. The route now adopted is a diagonal from the port terminal of the original west route to the inland terminal of the eastern one. Its estimated cost, including the Matanuska branch, is \$26,800,000, or \$61,000 per mile. This compares with \$19,324,000, or \$45,000 per mile, the estimate of the first commission for the same work. To accomplish what was originally proposed, by the construction of the cheapest line possible to the Bering River coal fields, and a 229-mile branch of the main line to the Kuskokwim River, would, according to the estimates in the original report, cost \$14,814,500 additional. Judging from the comparative estimates of the two commissions this figure might easily become \$18,000,000. In short, the Kuskokwim extension could not, though the short Bering River line could, be built within the original appropriation.

Considering the small amount of time at the disposal of the original commission, it is not surprising that more thorough studies have resulted in estimates 25 per cent higher. The amount of development, moreover, that can be expected for the \$35,000,000 appropriated seems to shrink yearly. Originally it was loosely stated that the Government was to build or acquire 1000 miles of line. The first commission found that the construction of 733 miles would use up the fund, with apparently nothing left for buying the private lines needed to complete the systems. The present commission estimates that it will take all but \$7,050,000 for 509 miles, of which 71 are acquired as completed line at a very low price. At the same rate it will be possible to build only about 115 miles, making a total of 624, and one is impelled to wonder whether the garment will shrink still further with the next washing.

There is food for thought in the price to be paid for the Alaska Northern. As above stated, the estimated costs per mile of new construction range from \$42,500 to \$61,000. In contrast to this, the price agreed upon for the existing Alaska road is \$16,200 per mile. Apparently, therefore, the Government is getting the property for less than half what it might be expected to be worth. If the legitimate business could be counted upon to earn satisfactory returns only on this diminished value there would be ground for serious apprehension as to the ability of the Government to make the projected lines profitable. It appears, however, that the low value placed by the owners is due to the closing of the coal fields after the road had been built in good faith. The willingness of the Government to take over the property at the minimum figure savors strongly of sharp practice, if not of confiscation.



THE MILFORD TURNPIKE IN THE MAKING AND APPEARANCE OF CONCRETE SURFACE AFTER A YEAR'S SERVICE

Concrete Road with a Single Crack in $4\frac{1}{4}$ Miles the Result of Careful Construction

On Connecticut Turnpike Preparation of Subgrade, Long Mixing of Each Batch of Concrete, Use of Reinforcement, and Grading of Aggregates Were Features

A SINGLE crack in a year-old concrete pavement $4\frac{1}{4}$ miles long—this is the result of the carefully planned construction routine insisted upon by the Connecticut State Highway Department in the building of the Milford Turnpike, a heavily traveled route between New Haven and Bridgeport. Before work was begun last spring it was planned to make this the model road of the State highway system and particular care was given to the details of construction. Among the features to which special importance is attached are the following: Thorough rolling of the subgrade; adequate provision for drainage; a specified minimum time for the mixing of each batch of concrete; careful grading of the concrete aggregates; thorough washing of sand; curing of the finished road; accurate measurement of concrete materials in boxes instead of rough wheel-barrow measurement; use of steel reinforcement; and

the placing of tar-paper expansion joints at 30-ft. intervals.

The Milford Turnpike is a single-course reinforced-concrete road, 18 ft. wide, with 5-ft. macadam shoulders. It is 8 in. thick at the center and 6 in. at the side and is reinforced with the American Steel & Wire Company's No. 29 wire mesh. The new pavement rests upon an old macadam foundation which had begun to show signs of wear. The road was completed Aug. 14, 1914, at a contract cost of \$68,271.28. This cost reduces to \$15,914 per mile, including drainage and grading. The maximum grade is 5.8 per cent.

PROVISION FOR DRAINAGE

Before the construction season opened a thorough examination of the old macadam road was made to detect poorly drained sections. After a heavy rain, when the frost was leaving the ground, these bad spots were located with stakes, and when work began they were replaced by a 15-in. sub-base of washed gravel, varying in size from $\frac{1}{4}$ to $1\frac{1}{2}$ in. This gravel sub-base was drained into the side ditches at suitable intervals. In Connecticut the experience has been that a gravel foundation of this type is more satisfactory, under concrete, than a telford base, for it is less subject to the influence of frost. The 15-in. gravel base can be put in at the same price as an 8-in. telford foundation.

In preparing the new sub-base, which is flat, a definite policy of cutting down the old macadam crown was adopted. If the full thickness of the old 7-in. surface at the center line of the road had been used to support the new pavement the fill necessary to bring the grade horizontal at the shoulders would have been excessive, and even if rolled thoroughly might have settled and caused cracking in the finished concrete. On the other hand, if too deep a cut was made at the crown the full supporting value of the old road surface would not have been realized. On the Milford Turnpike the depth of cut at the crown was fixed at $3\frac{1}{2}$ in., giving a fill of 2 in.

at the side, using the material which had been removed from the center of the roadway.

Where it was necessary to put in the gravel sub-base particular attention was given to making the foundation compact, and the material was watered and rolled to a solid bearing with a 15-ton steam roller. On side hill work a drain, 2 ft. wide and 40 in. deep, filled with crushed stone, was constructed on the uphill side to intercept the water before reaching the road bed, and 6-in. tile pipe with open joints was used to carry the water.

CONCRETE AGGREGATES

The coarse aggregate for the concrete was a local trap rock with high abrasive qualities. Coarse sand was used and the washing of the fine aggregate was made compulsory. For the sand it was specified that not more than 15 per cent should pass



DEEP DITCHES INTERCEPT DRAINAGE ON SIDE HILL WORK



A ROCK CUT ON THE ROUTE OF THE MILFORD TURNPIKE



TAR-PAPER JOINT AS ORIGINALLY FORMED—
NOTE TRANSVERSE BROOM MARKS

a 50-mesh sieve and that the tensile strength should equal that of briquettes made with standard Ottawa sand. The contractor was required to deliver the stone on the work in three sizes— $\frac{1}{2}$, $\frac{3}{4}$ and $1\frac{1}{4}$ in. No mixing of these sizes was permitted before delivery. When the stone reached the work tests were made to determine the proportions for the densest mixture and the one which could be worked to best advantage, special attention being paid to these points. The value of washing the sand was proved conclusively by an experience on a nearby contract, where this requirement was not made, and where the work was of an inferior quality as a result. All of the cement was required to pass the test of the American Society for Testing Materials.

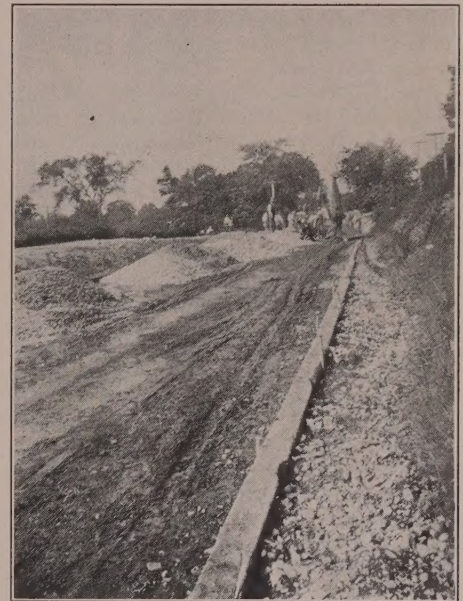
PLACING CONCRETE

The mixture used was one part Alsen Portland cement, two parts sand and four parts crushed trap rock. These materials were mixed in a Koehring machine and

delivered to place by a bucket and boom. A rigid rule was enforced requiring the contractor to turn each batch in the mixer at least $1\frac{1}{2}$ min. The good quality of concrete produced is attributed in part to this feature of the construction routine. The progress in concreting was 300 ft. of 18-ft. roadway per day of 9 hours, amounting to about 120 cu. yd. of concrete.

BOOM MIXER USED

It was noted that the boom bucket which received the mixed concrete was not water-tight and that after the plant had been in place for a while the drippings of cement and sand grout formed a small mound under the loading point. If this mound of material had been allowed to remain in place it would have produced a soft spot in the finished pavement, for since it contained no coarse aggregate it would have had slight resistance to the abrasion of passing traffic. These mounds of grout, therefore, were always removed whenever the position of the mixer was changed and were replaced with concrete containing the



STRINGERS AGAINST WHICH SHOULDERS OF
THE CONCRETE PAVEMENT ARE CAST



TAR-PAPER JOINT TREATED WITH TAR AND
SAND AS MAINTENANCE MEASURE

standard proportions of coarse stone. This is one of the small details of the work, which are believed to have been responsible for good results.

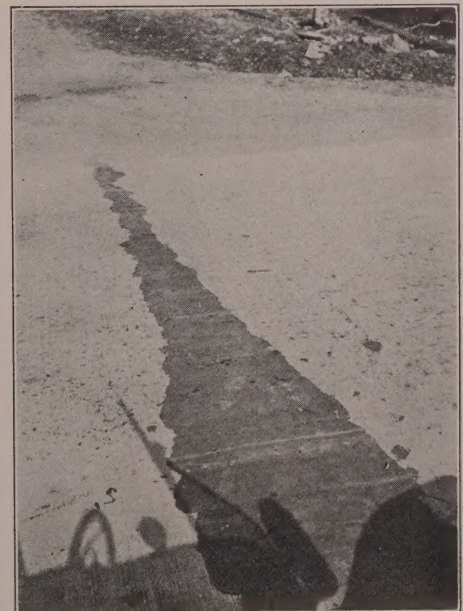
The wire mesh reinforcement was delivered in rolls 60 in. wide and was laid transversely. At places where bad spots had existed in the old sub-base the reinforcement was placed near the bottom of the concrete slab to take up any stress due to settlement. Elsewhere the steel was placed 2 in. below the top surface, to counteract any heaving due to frost action.

EXPANSION JOINT

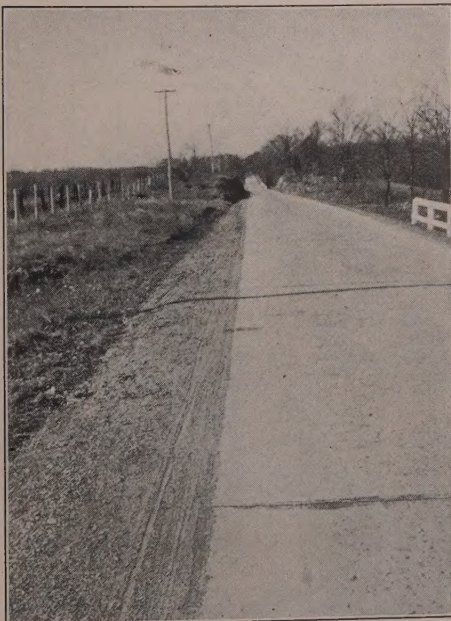
The pavement was laid in 30-ft. sections with an expansion joint of three thicknesses of tar-paper between sections, when the weather was cool, and two thicknesses during the warmest period. For the placing of these joints a $\frac{1}{2}$ -in. pine board was set up across the roadway and the tar-paper tied to it with string, allowing about $\frac{1}{2}$ in. of the paper to project above the finished surface of the roadway. A split float, straddling the expansion joint, was used to bring the surface of the concrete

to the same elevation at each side, thus avoiding any bump in the finished work which the wheels of passing vehicles would chip off. When the concrete had reached its final set the projecting tar-paper was cut off a quarter of an inch above the surface of the road with a shovel, and when traffic was allowed on the road the projecting edges of the paper were broomed over, forming a protection for the edges of the concrete. Joints of this type have given about a year's service and then are treated with a mixture of tar and sand, a maintenance operation costing about \$15 per mile. As a result of the experience on the Milford Turnpike the engineers of the Connecticut State Highway Department believe that the tar-paper joint is better than steel, for with a steel joint it is difficult to bring the top surface of the concrete to the same curve as the steel plate. The steel joint also adds about 4 cents per square yard to the cost of the pavement.

Parallel to the center line of the roadway at either side are placed 6 x 6-in. wooden



TAR TREATMENT AT THE ONLY JOINT WHERE
FROST HEAVED SLAB SLIGHTLY



NO RUTTING AT MACADAM SHOULDERS HAS
DEVELOPED DURING A YEAR'S SERVICE

stringers held in position by 1-in. iron pins. These stringers serve as the side forms for the concrete work.

The pavement is floated from a plank bridge, and is scored transversely with rattan brooms to prevent slipperiness. The screeds used are 2½-in. plank with iron shoes, resting upon the 6 x 6-in. wooden stringers.

A FEW CONSTRUCTION DETAILS

In forming the joints it is important not to work the concrete so that cement mortar alone is present at the end of the section. If this happens the joint will be weak and will chip off quickly under traffic. It is essential to have a certain quantity of stone at the end of each section to resist abrasion.

Another detail of construction which experience has shown is well worth following is the accurate measurement of concrete aggregates prior to their delivery to the mixer. On the Milford Turnpike no ordinary wheel-barrows were allowed for this purpose. Instead, the wheel-barrows were fitted up with calibrated boxes. With these devices available for accurate measurements there was no guesswork in the proportioning of the concrete. One of the accompanying photographs shows the box wheel-barrows in use.

The final operation in the construction of the concrete road consisted in covering it with 2 in. of earth, which was kept moist for a period of 8 days. Water was pumped from the river to a standpipe at the middle of the job through a 2-in. pipe line laid by the contractor. No section of the road was opened to traffic until two weeks after the concrete had been placed.

CONDITION OF CONCRETE ROAD

An inspection of the Milford Turnpike last month, after it had been in service almost a year and when all frost had left the ground, showed that the surface was in excellent condition. In the entire 4¼ miles of length only one hair crack was discovered. This was a fine crack about 3 ft. long, extending diagonally across the corner of one slab. It was barely wide enough to admit the point of a blade of a jack knife. The blade did not enter into the surface more than ⅛ of an inch. There was only



WHEELBARROWS FITTED WITH BOXES FOR ACCURATE MEASUREMENT OF CONCRETE AGGREGATE



SPLIT FLOAT USED TO STRADDLE PROJECTING TAR PAPER AT JOINTS

one spot where frost had heaved up one corner of a slab slightly without cracking the slab. This condition is shown in one of the pictures. A liberal application of tar served to smooth over the irregularity in elevation at this place and has no effect upon traffic.

The joints between sections all appear to be in excellent condition and no chipping or unevenness was apparent. Many of the joints have been treated with an application of Tarvia X and clean coarse sand since the work was completed and the appearance of a typical joint is shown in one of the photographs.

The macadam shoulders on either side of the roadway have been well maintained, and an idea of their condition is indicated in a picture. No rutting at the edge of the concrete has taken place.

The transverse marks by the fiber brooms are still visible and in wet weather prevent the pavement from becoming unduly slippery.

At a few places where, apparently, a film of cement grout had hardened on the surface, small irregular patches have flaked off under traffic. These are not holes or depressions, but are merely the rubbing away of what might be termed a thin veneer of cement. With this veneer removed the surface is dense and hard. These patches were observed on only a very few sections of the turnpike. For its entire length the concrete roadway exhibited a smooth clean surface.

COST

The contract price for the Milford Turnpike was \$5.65 per cubic yard for the concrete, or \$1.13 per square yard, to which should be added 8½ cents per square yard for steel reinforcement. The contractors were C. W. Blakeslee & Sons of New Haven.

Charles J. Bennett is State Highway Commissioner, R. L. Saunders, deputy commissioner in charge of construction, and O. W. Head division engineer for this section of the work.

SPAIN'S RAILWAYS total 9377 miles, of which 7135 miles are of so-called normal gage (5.48 ft.) and 2235 miles of other gages, chiefly 1 meter or 3.28 ft.

Seward-Susitna Route Chosen for Alaska Railroad

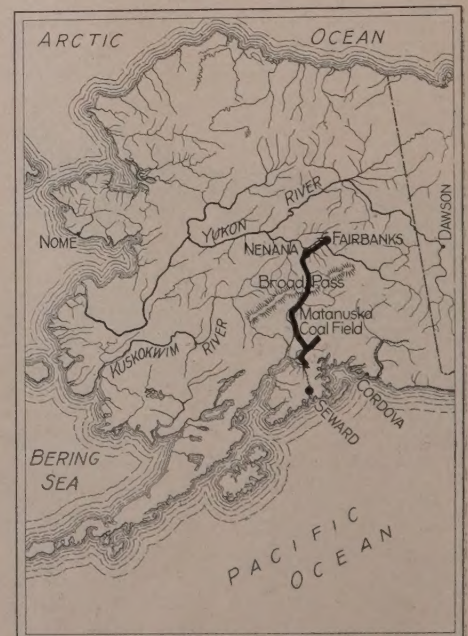
Government Will Hardly Build More Than Forty Miles This Year and Will Employ Only a Few High-Grade Engineers

THE SUSITNA route, so-called, has been determined upon for the railroad the United States Government proposes to build in Alaska. The project involves the purchase for \$1,150,000 of the 71-mile Alaska Northern Railroad from Seward on Resurrection Bay to Turnagain Arm, and the construction of a 400-mile extension from the latter point up the Susitna valley and through Broad Pass to Fairbanks, with a 38-mile branch into the Matanuska coal field. The total estimated cost of construction, including the branch line, is \$26,800,000.

THE ROUTE

The approved route, which is shown on the accompanying map, is described as follows:

"Commencing at the town of Seward on the westerly shore of Resurrection Bay, Alaska; thence following along said westerly shore in a northerly direction to the head of said bay; thence following up the drainage of Salmon Creek to a summit between said drainage and the drainage of Snow River; thence following the drainage of Snow River to Kenai Lake; thence continuing northerly along the easterly shore of Kenai Lake; along Falls Creek, along the shores of Lower and Upper Trail Lake, and up Trail Creek to a summit in the Kenai Mountains near mile 45 from Seward; thence descending along the drainage of Placer River to the head of Turnagain Arm of Cook Inlet; thence following the northeasterly shore of said Turnagain Arm and crossing Portage Creek and Twenty-Mile River to the mouth of Kern Creek near mile 71 from Seward; thence in a northwesterly direction along the shore of Turnagain Arm to near the mouth of Big Rabbit Creek; thence leaving Turnagain Arm and running northerly to a summit in section 26, Township 14 North, Range 3 West, Seward meridian; thence



ADOPTED ROUTE, INCLUDING BRANCH

Note existing Alaska Northern Railroad extending north from Seward

running northeasterly to near the head of Knik Arm of Cook Inlet; thence running northerly across the flats at the head of said Arm and crossing Knik and Matanuska Rivers, to a point about 2 miles north of the Matanuska River; thence running in a westerly and northwesterly direction, crossing the little Susitna River and following along the southwesterly slopes of Bald Mountain to Willow Creek, a tributary of the Susitna River; thence in a northerly direction following the drainage of the Susitna and Chulitna Rivers to Broad Pass, situated in the main Alaska Range of mountains; thence crossing Broad Pass and entering the drainage of the Nenana River; thence continuing northward following the drainage of the Nenana River to the Tanana River, the total distance from Seward being 416 miles, more or less.

"Also starting from a point on the above described line, situated 2 miles more or less northerly from where said line crosses the Matanuska River, and thence running in an easterly direction following the drainage of said Matanuska River and its tributaries, a distance of 38 miles more or less to the Matanuska Coal Fields."

HOW THE WORK IS TO BE DONE

The work is to be carried on, according to an order issued by President Wilson, by the Alaskan Engineering Commission, whose members are W. C. Edes, Lieut. Frederick Mears and Thomas Riggs, Jr. Mr. Edes, chairman, has been designated to have charge of the assignment of duties to the heads of departments, and the fixing of salaries, subject to the approval of the commission as a whole. The commission has been instructed to proceed to Alaska at once. Mr. Edes will make his headquarters at Seward, Lieutenant Mears will make his headquarters at Ship Island and Mr. Riggs is to conduct surveys in the Broad Pass region.

That the health of the men engaged in the construction work and their compensation in case of accident are to be given careful attention is indicated by the following order from the President: "I charge the commission particularly with the preparation and maintenance of such arrangements as may be required for the health of the men engaged in the work of construction and I instruct you to prepare and adopt a proper system of compensation for accidents which may occur on the work, in general on the lines of the system now in force in the construction of the Isthmian Canal, but such system shall be so framed that its benefits will be applicable not only to those who are directly in the service of the commission upon salary, but also to those who may, by contract with the commission, be actually engaged in the work of construction in Alaska."

OPPORTUNITIES FOR EMPLOYMENT LIMITED

A warning against any stampede of men to Alaska this year in anticipation of finding employment on the work is sounded by Franklin K. Lane, Secretary of the Interior, who states that few other than a small number of engineers of a high grade will be employed, that there is little opportunity for other employment in Alaska at this time, and that those who go there must be prepared in advance for their return in the fall. A payment of \$500,000 must be made July 1 to the present owners of the Alaska Northern Railroad, and the remaining \$650,000 is due July 1, 1916.

Quoting Mr. Lane, "The first work will be the building of a wharf at Ship Creek and the dredging of a more adequate channel. From this point the railroad will be constructed northward to the Matanuska field.

"The probability is that not more than 40 miles of road can be constructed this year, owing to the fact that our appropriation is but \$2,000,000. We have something over \$500,000 remaining from the \$1,000,000 last year authorized, and this will be used as the first payment on the Alaska Northern road.

"The work will be done in large part by station men, who will make direct contracts with the commission for building distinct

units of the road. This method has been recommended to the President by some of the most prominent railroad constructors and is adopted very generally in railroad construction in the West. At the end of this season the work done in this way will form a basis from which it may be determined whether it is wise to have the road constructed as a whole or in parts by contract.

"It is expected that the commission will employ a very small force, chiefly composed of engineers, to supervise the construction. The President has directed the commission that the few places which are to be filled shall be filled exclusively upon the ground of merit and experience."

Hydrant Tests in Chicago Indicate Cheaper Maintenance Possibilities

City Engineers Make Elaborate Series of Experiments in Order to Determine Losses of Head in Various Parts of Hydrants

LOSS of head in fire hydrants due to friction was investigated by the engineering department of the City of Chicago in a series of tests recently completed. This study was brought about as a result of an investigation to determine the high maintenance cost of fire hydrants. It was found that the two principal causes were, first, the great number of uses to which these hydrants were put, with the consequent frequent repairs required, and, second, the design of the hydrant in general use throughout the city, which is such as to require an excavation and the removal of the entire hydrant when repairs were to be made to the inlet valve, one of the most common points of trouble.

Plans are now being made to eliminate many of the undesirable uses to which fire hydrants are being subjected and carefully to supervise all necessary service other than for fire protection. Such regulations are expected to reduce the amount of maintenance work required to a large extent.

In order to reduce the cost of repairs to a minimum it was decided to compare the hydrant in use at the present time with hydrants of various manufacturers and to design a hydrant, adopting such features from the different hydrants as were of the

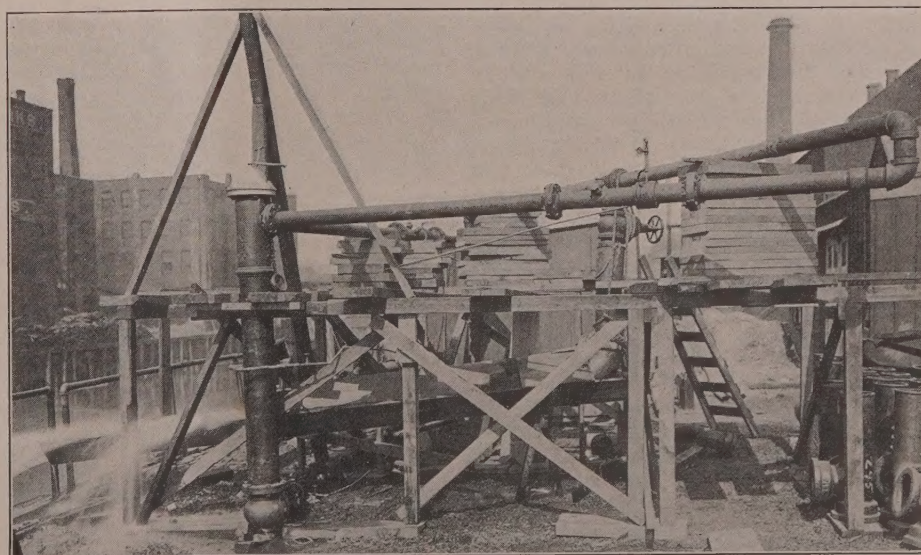
best mechanical and hydraulic design to properly perform their respective functions.

To determine the comparative value of the various designs as to hydraulic properties four hydrants of different makes were purchased and these together with the city's hydrant were tested. All the hydrants were equipped with two 4-in. nozzles, independent valves on the nozzles, 6 $\frac{1}{8}$ to 6 $\frac{1}{4}$ -in. inlet valves and 6-in. leads.

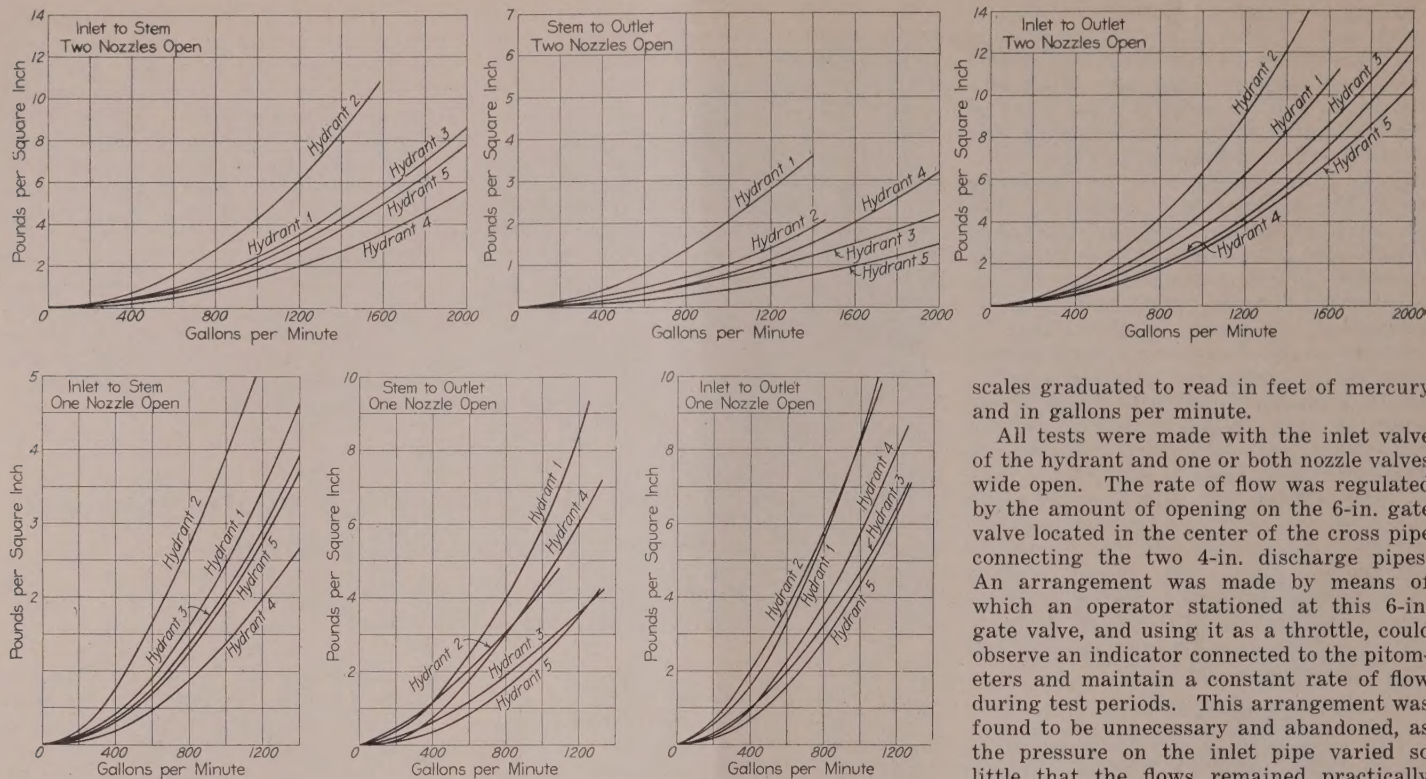
TEST METHODS

Water for the tests was obtained through a 12-in. tap from a 12-in. main extending from the Twenty-second Street pumping station to a nearby pipe yard. The 12-in. pipe extension, as shown in the general layout drawing, was reduced to an 8-in. cast-iron pipe and then to a 6-in. wrought iron pipe, all laid along the surface of the ground. The hydrants tested were connected at the end of this extension.

To insure accurate pressure readings 4-in. wrought-iron pipe was connected to each of the nozzles by means of special flanges and the pressure connections were taken off these pipes at points far enough from the hydrant to eliminate possible faulty readings due to disturbed currents entering the piezometer chambers. These



TRIANGULAR FORM OF OUTLET PIPING INSURES EQUAL DISCHARGE FROM EACH NOZZLE



LOSS OF HEAD DUE TO FRICTION IN FIRE HYDRANTS

wrought-iron pipes were connected to short risers which insured a full pipe at the piezometer sections under any condition of flow. The risers were connected to a common outlet orifice controlled by a gate valve.

All the piping leading from the nozzles was made symmetrical about the common outlet so that there would be nothing to cause unequal flows in the two pipes, a condition which would make it almost impossible to correct properly the pressure readings taken for differences in velocities between inlet and outlet piezometer sections. The piezometer sections were also fitted with corporation ferules, carefully installed flush with the inside of the pipe, through which pitometers could be inserted to determine to what extent the flows varied.

POSITION OF OUTLET PIPE CHANGED

When the first hydrant was installed and preliminary tests run, the outlet pipe was placed in a horizontal position as shown in the diagram, and an elbow was screwed on which discharged the water in a direction parallel to the cross pipe. Under this condition the flow in the two pipes varied by about 2 ft. per second in velocity. This variation was eliminated by turning the discharge pipe down as shown in photograph. To check these flows during all rates of discharge without constant testing with a pitometer, and to insure a correct average, if slight variations in flow should occur, separate differential gages were connected to each of the outlet piezometer sections instead of connecting both to a common pressure header.

In order to compare the resistance of the different inlet valves and outlet orifices, as well as that of the entire hydrant, differential gages were also connected from the inlet to the middle of the hydrant stem and from the outlets to the middle of the stem. The inlet pressures were taken 2 ft. in front of each hydrant and no correction

was made for the loss in the 2 ft. of 6-in. smooth tubing. To determine the proper connection for the resistance in the 9-ft. sections of 4-in. discharge pipes between nozzles and piezometer connections, one of these 9-ft. sections was attached to the 4-in. branch shown in the assembly drawing and a friction loss curve determined by test.

TWO PITOMETERS USED

The rate of flow during test periods was determined by pitometer measurements. For this purpose two pitometers were used, one inserted in the 12-in. pipe and one in the 8-in. pipe. The use of the two pitometers permitted the operator to check one instrument against the other during the intermediate rates of flow, and also to read from the minimum to the maximum rates of flow obtained, with a very sensitive gage without changing the gage liquid, that is, by reading low flows on the 8-in. pipe and high flows on the 12-in. pipe.

All differential gages were bent glass tubes charged with heavier-than-water liquid. The gages connected to piezometer sections were charged with mercury and those connected to pitometers were charged with a mixture of gasoline and carbon-tetrachloride. The gages were fitted with wood

scales graduated to read in feet of mercury and in gallons per minute.

All tests were made with the inlet valve of the hydrant and one or both nozzle valves wide open. The rate of flow was regulated by the amount of opening on the 6-in. gate valve located in the center of the cross pipe connecting the two 4-in. discharge pipes. An arrangement was made by means of which an operator stationed at this 6-in. gate valve, and using it as a throttle, could observe an indicator connected to the pitometers and maintain a constant rate of flow during test periods. This arrangement was found to be unnecessary and abandoned, as the pressure on the inlet pipe varied so little that the flows remained practically constant.

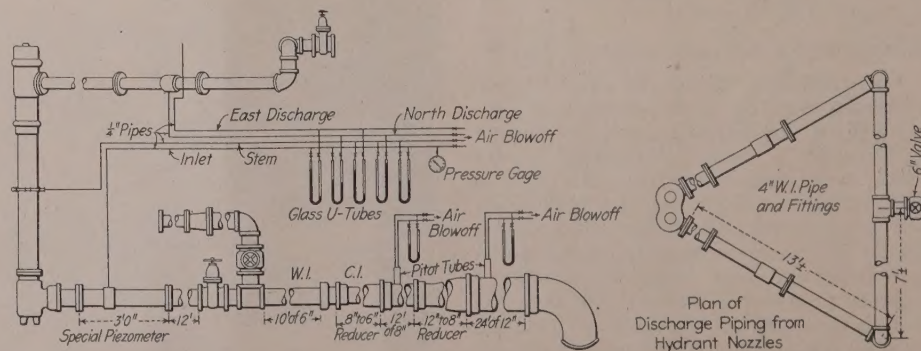
SEVEN RATES OF FLOW

Each of the fire hydrants was tested under seven different rates of flow with both nozzles open and with one nozzle open. Ten readings were taken at each rate of flow at half-minute intervals. All gages were read as nearly as possible at the same instant, one reader acting as director and giving a signal for reading.

The differential gage readings were corrected for the difference in velocity head as computed from the average velocities in their respective piezometer sections. The total loss for hydrant, as indicated by the differential gage, was corrected by subtracting the loss in the 9-ft. section of 4-in. discharge pipe.

In addition to the tests of all the hydrants working under normal conditions, as stated above, several special tests were made on hydrant No. 1, which contains a secondary inlet valve. The tests determined the effect produced by varying the position of this valve.

The tests were carried out by W. R. Brown, assistant engineer to M. B. Reynolds, engineer of waterworks design. The designing division is a department under the general direction of John Ericson, city engineer, and H. S. Baker, assistant city engineer.



ARRANGEMENT OF PIPING, GAGES AND PIEZOMETER FOR HYDRANT TESTS

Cylinder Gates Increase Turbine Efficiency

Compared with Wicket Gates in Holyoke Tests
They Show Superiority for Openings
Greater than One-Half Gate

By A. G. HILLBERG

Wegmann & Hillberg, Hydraulic Engineers,
New York

COMPARITIVE tests of cylinder gates and wicket gates for regulating the flow of water through turbines, made at the Holyoke flume, indicate that for all gate openings greater than one-half gate the cylinder gate gave higher efficiencies. Wicket gates seem to be the most favored device for regulating the flow of water through turbines. On smaller waterwheels these gates become very delicate and are liable to damage should they jam or become obstructed by foreign bodies. The cylinder gate in many respects is considered better, but engineers in general believe that such gates reduce the efficiency of the wheel.

In cases where cylinder gates have been used, as for instance in several of the plants at Niagara Falls where the power stations are allotted certain quantities of water and the units operate at full capacity most of the time, their selection has been governed by the fact that efficiency at small gate openings is a negligible factor. In several plants in Norway cylinder gates have been used because the frazil and

anchor ice conditions are so severe that it would be almost impossible to keep wicket gates in operating condition during the winter months.

Wicket gates are favored by many engineers because they believe that such gates are balanced, thus requiring governors of smaller capacities than other types. This, however, is not correct, as theoretically the wicket gates are balanced in one position only. In practice they are never balanced because eddy formations and the constant shifting of the flow lines upset the theoretical calculations in this respect.

THE HOLYOKE TESTS

In order to determine the influence of cylinder and wicket gates on the efficiency, discharge and power of turbines, the Holyoke Machine Company, of Worcester and Holyoke, Mass., has tested two 36-in. runners in the Holyoke testing flume. These runners were identical, except that one was designed left-hand and the other right-hand. One of the tests, No. 2266, was made with the left-hand runner and using sixteen wicket gates; the other, No. 2317, with the right-hand runner using a cylinder gate mounted inside a speed ring with seventeen blades made of plate steel.

The test results are shown on the accompanying diagrams and they indicate that for all gates above one-half the cylinder gate is superior to the wicket gates. The maximum efficiency at full gate for

wicket gates was 83 per cent; at 0.895 gate, 86 per cent; at 0.736 gate 86 per cent; and at 0.632 gate 81 per cent. The efficiencies obtained with the cylinder gate were, at full gate, 89 per cent; at 0.890 gate, 88 per cent; at 0.780 gate, 85 per cent; at 0.637 gate, 82.7 per cent; and at 0.520 gate, 78 per cent. The operating head during the tests was 16 ft.

The objectionable condition of having an unbalanced cylinder gate has been overcome in different ways. At Niagara Falls the governor operates the gate through a set of levers so designed that they balance the weight of the gate. The designer of the cylinder gate for the 36-in. test runner, however, equipped the lower lip of the gate with an annular inclined flange so designed that the pressure on it, due to the velocity change in the bellmouth thus formed, balanced the weight of the gate.

The test runners and the gates were designed by W. D. White, hydraulic engineer, of the Holyoke Machine Company.

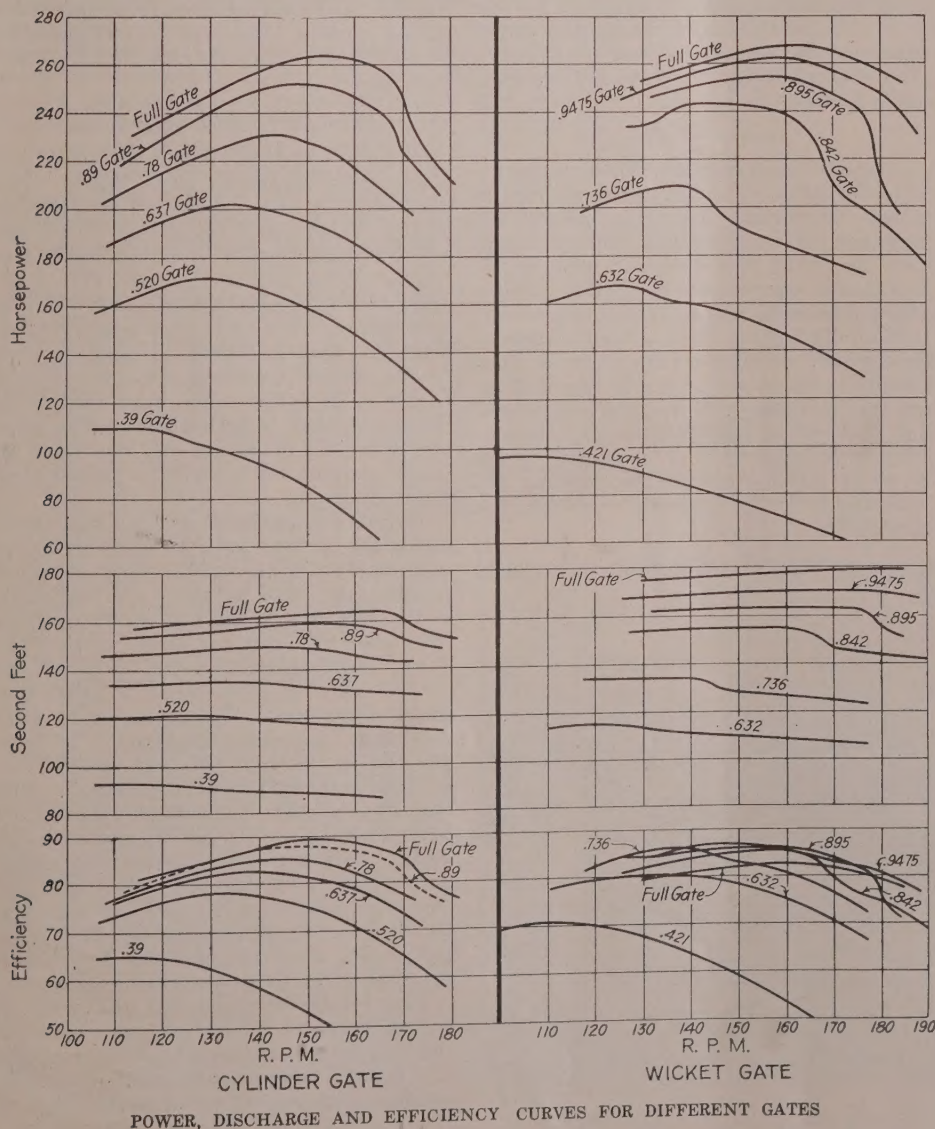
Progress of Federal Evaluation

THREE new orders, states Thomas W. Hulme, general secretary of the Presidents' Conference Committee, have been issued since March 1 by the Interstate Commerce Commission in connection with the Federal evaluation of the railroads. Order 11 requires an inventory of the accounting and other book records of the carriers. Order 12 calls for a schedule of industrial side tracks. Order 13 gives the director of valuation the option of demanding a general inventory of all of the carrier's property except land and equipment. Order 14 is also about to be issued, and will require certain carriers to furnish detail information as to prices paid within recent years for materials and labor. The commission still has under consideration the form of orders requiring information as to certain classes of leases, and information in connection with land grants, aids, gifts, donations and concessions.

In connection with Order 13 the director of valuation has stated that it is not the intention to require a carrier to cross-section its property, nor generally to prepare inventories where the carrier is willing to co-operate with the Government along the lines that have developed. It is the intention to require of carriers having large terminals the preparation of detail information in connection therewith, and the carriers' organization feels that such work can best be done by the carriers.

The general valuation conference, originally announced for March 22 and subsequently postponed until April 19, has again been postponed and is now scheduled for May 27.

The work of the Government field forces for the Eastern District during the past winter has been principally on the Winston-Salem line and on the Pennsylvania lines south of Philadelphia, mostly on the Delaware, Maryland & Virginia peninsula, to which they were transferred from the Boston & Maine at the beginning of winter. It is expected that most of these forces will be returned to New England for work on the Boston & Maine and the New York, New Haven & Hartford during the summer of 1915. The field forces in the Southern District have been engaged in completing their work on the Atlanta, Birmingham & Atlantic and the Central of Georgia, have



started the work on the Georgia Southern & Florida and have surveyed more than 500 miles of the Cleveland, Cincinnati, Chicago & St. Louis. In the Central District the Government forces were at work during the winter on the Illinois Central south of the Ohio River and on the St. Louis Southwestern. In the Western District they have largely concentrated their work on the Rock Island lines. In the Pacific District they have practically completed the field work on the Atchison, Topeka & Santa Fé in Arizona, and on the Western Pacific in California. It is expected that they will resume work on the roads in the Northwest during the summer, it being understood that it is the intention to complete if possible during the present year the work on the Great Northern.

Additional roads as follows have been notified that they are to be valued: Arizona Eastern, Phoenix & Eastern, Bangor & Aroostock, Bessemer & Lake Erie, Chicago, Indianapolis & Louisville, Cleveland & Pittsburgh (Pennsylvania Lines West), Georgia Railroad & Banking Company, Great Northern Railway, Montana Western Railway, Farmers' Grain and Shipping Company, Brandon, Devils Lake & Southern, and Southern Pacific Company (lines in Arizona).

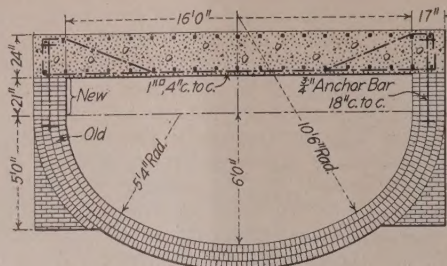
Removal of "Bottle Neck" Augments Flow in Sewer

Sides of a Flat-Topped Sewer Raised and Concrete Covered Top Used as a Sidewalk and Base for Pavement

AN INCREASE in population and in roof and pavement area in Omaha rendered the Jones Street trunk sewer, draining 2200 acres of territory, inadequate to carry the consequent more rapid runoff during heavy rain storms. Frequent blow-outs were caused by the pressure from a backed-up flow. At Jones and Sixth Streets a "bottle neck" or contraction in the sectional area existed.

Originally the sewer consisted of a semi-circle of brick covered with a flat top made up of 15-in. I-beams set on 5-ft. centers and between which three-ring brick arches were turned. As the top was nearly at the street grade the usual passive pressure due to earth cover was absent.

In rebuilding the sewer after the top was removed the sidewalls were raised 2 ft.



SECTION OF BRICK-REINFORCED CONCRETE
SEWER IN OMAHA

and on 18-in. centers $\frac{3}{4}$ -in. rods were built into the brick work to form anchors for a reinforced concrete slab roof, 24 in. thick under the roadway and 17 in. thick under the sidewalk. In the latter case the cover forms the sidewalk and the side nearest the road is carried out over the brick wall for 6 in. and down 3 ft. to form a curb.

At the Sixth Street intersection the concrete is covered with granite block pavement to a point where a sand cushion is no longer possible and then asphalt is used to round off the pavement to conform with the rest of the intersection. The anchors will make the cover withstand considerable internal pressure above its own weight. The "bottle neck" was entirely removed and the sewer increased in cross-section here as at other points by 28 sq. ft.

The work was carried out by day labor under the supervision of William Hutton, superintendent of sewers; the plans having been made by William J. Provaznik, sewer engineer, who also supervised the field engineering, reporting to Watson Townsend, city engineer.

CHICAGO STERILIZES 170,000,000 GALLONS of water daily with hypochlorite of lime at three intake cribs. A uniform rate of 0.1 parts per million of available chlorine is applied, according to a statement made by H. S. Baker in a paper presented March 19 before the Lake Michigan Water Commission. During the coming year a liquid chlorine plant will be installed at the Chicago Avenue pumping station, where it will be easier to control the treatment than when it is located 2 or 3 mi. out in Lake Michigan. It is possible to determine the exact amount taken by every pump, while at the cribs no apparatus has been installed to measure the greater flow.

Weathering of Concrete Prevented by Waterproofing

The Reclamation Service Treats Vertical Surfaces With Soap and Alum and Horizontal Surfaces With Paraffine

CONCRETE surfaces on structures in the Strawberry Valley project, Utah, of the U. S. Reclamation Service, are prevented from weathering by waterproofing. The storage works and tunnel are located in the Wasatch Mountains at an elevation of 7500 ft. and severe winter weather is encountered, temperatures of 50 deg. below zero being recorded. According to J. L. Lytel, project manager, in the "Reclamation Record," the extreme cold, with alternate thawing and freezing of water in the pores was found to have a destructive effect.

It was decided to treat the vertical surfaces with alum and soap solutions and the horizontal surfaces with paraffine. The alum solution was made by dissolving 2 ounces of alum $[KAl(SO_4)_2]$ in 1 gal. of hot water. The soap solution was composed of $\frac{3}{4}$ lb. of castile soap dissolved in 1 gal. of hot water. The paraffine was boiled to drive off water as the presence of water rendered it hard to apply. Ordinary commercial products were used.

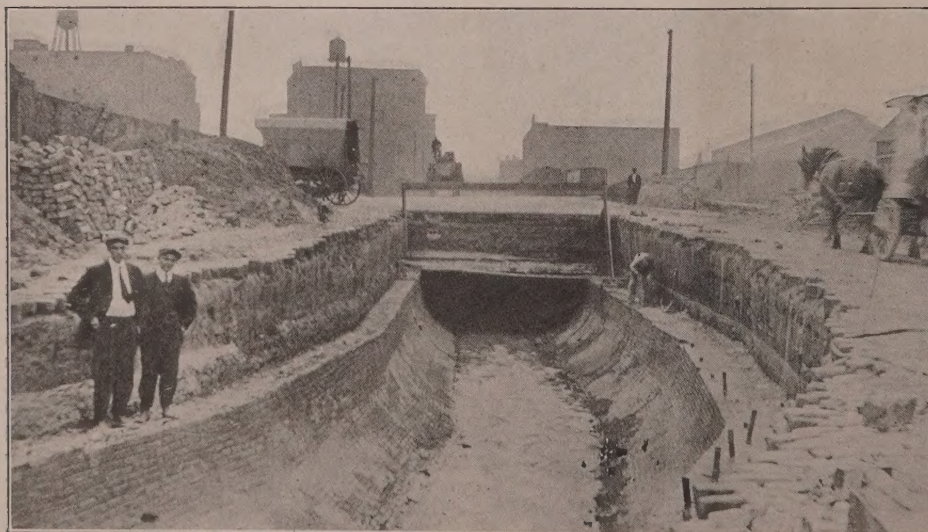
The surface to be treated with paraffine was first thoroughly dried and cleaned of loose concrete, dirt and other foreign substances. The paraffine was then heated and applied with a paint brush, and was forced into the pores by the heat of a blow torch on the surface. Only one coat of paraffine was applied, as the concrete would not absorb more.

APPLICATION OF SOLUTIONS

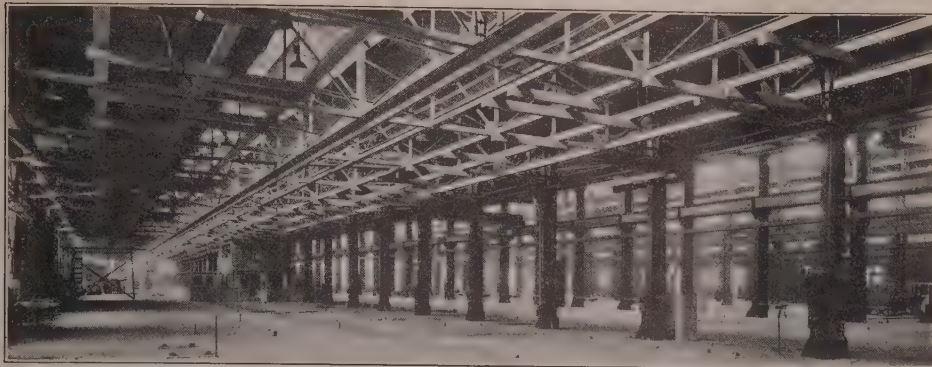
The surface to be treated with soap and alum was prepared as above stated. The alum solution was applied at a temperature of 100° Fahr. with a moderately stiff brush and was then worked in with a stiff horse brush. While the surface was still moist from this treatment the hot soap solution was applied in the same manner as the alum solution. One treatment by each solution in the manner described above constituted a coat. If other coats were considered necessary, they were applied in like manner after the preceding coat had been allowed to stand for a period of twenty-four hours or more.

Twelve structures were given this treatment, the surface area covered being approximately 28,000 sq. ft. Four thousand square feet were treated with paraffine, at the rate of 1 lb. for 11 $\frac{3}{4}$ sq. ft., and the remainder with soap and alum. It required 1 gal. of alum solution and a $\frac{1}{2}$ gal. of soap solution to cover 50 sq. ft. with two coats. Two coats of alum and soap were applied at an average total cost of 76 cents per 100 sq. ft., and the cost varied from 41 cents minimum to \$1.28 maximum. The cost of one coat of paraffine varied from \$1.70 to \$3.78 per 100 sq. ft., and averaged \$2.11. This cost covers everything except general expense. The two men who did this work received \$75 and \$80 per month. Brushes cost \$6.06, Castile soap, 12 $\frac{1}{2}$ cents per pound, alum 18 cents per pound, and crude paraffine \$4.80 per hundredweight.

The results obtained by this style of waterproofing are considered very satisfactory. The structures that were repaired and treated have gone through two severe winters and no further disintegration of the concrete on any part has occurred.



OLD BRICK ARCH TOP REMOVED READY FOR NEW SIDEWALLS AND SLAB ROOF



ARRANGEMENT OF LOCOMOTIVE SHOP GIVES SPACIOUS INTERIOR

One Large Building Houses All Departments of Locomotive Repair Shops

Innovation in the Additional Facilities Provided for the Chicago & Alton Railroad at Bloomington, Illinois

THE placing of all of the several departments of the locomotive shop under one roof is the principal innovation in the new shops of the Chicago & Alton Railroad at Bloomington, Ill. The layout of the blacksmith shop is also quite different from the usual practice.

The Chicago & Alton has had locomotive and car repair shops, together with an engine terminal, in Bloomington for a great many years.

The new group of buildings just completed, built to meet the necessity for increased capacity and more modern equipment, is located on a tract of land northerly of the location of the old shops and yards.

The general layout of the new plant comprehends provision not only for existing and probably future needs, but the utilization as far as possible of the old shops and

the relation of the whole to the development of a well defined scheme that will ultimately use the tract in the most economical and effective manner. As will be noted from the accompanying plan, the new layout consists of a centrally located locomotive shop building, an L-shaped blacksmith shop south of the locomotive shop, a two-story storehouse with a large storage platform east of the locomotive shop, and tire heating and flue rattler buildings.

Between the buildings are located yards for the storage of material, together with the necessary tracks and platforms for the requisite handling and trucking.

LOCOMOTIVE REPAIR SHOP

The locomotive repair shop is 619 x 317 ft., covering an area of nearly 4½ acres. Inside of this building are the erecting

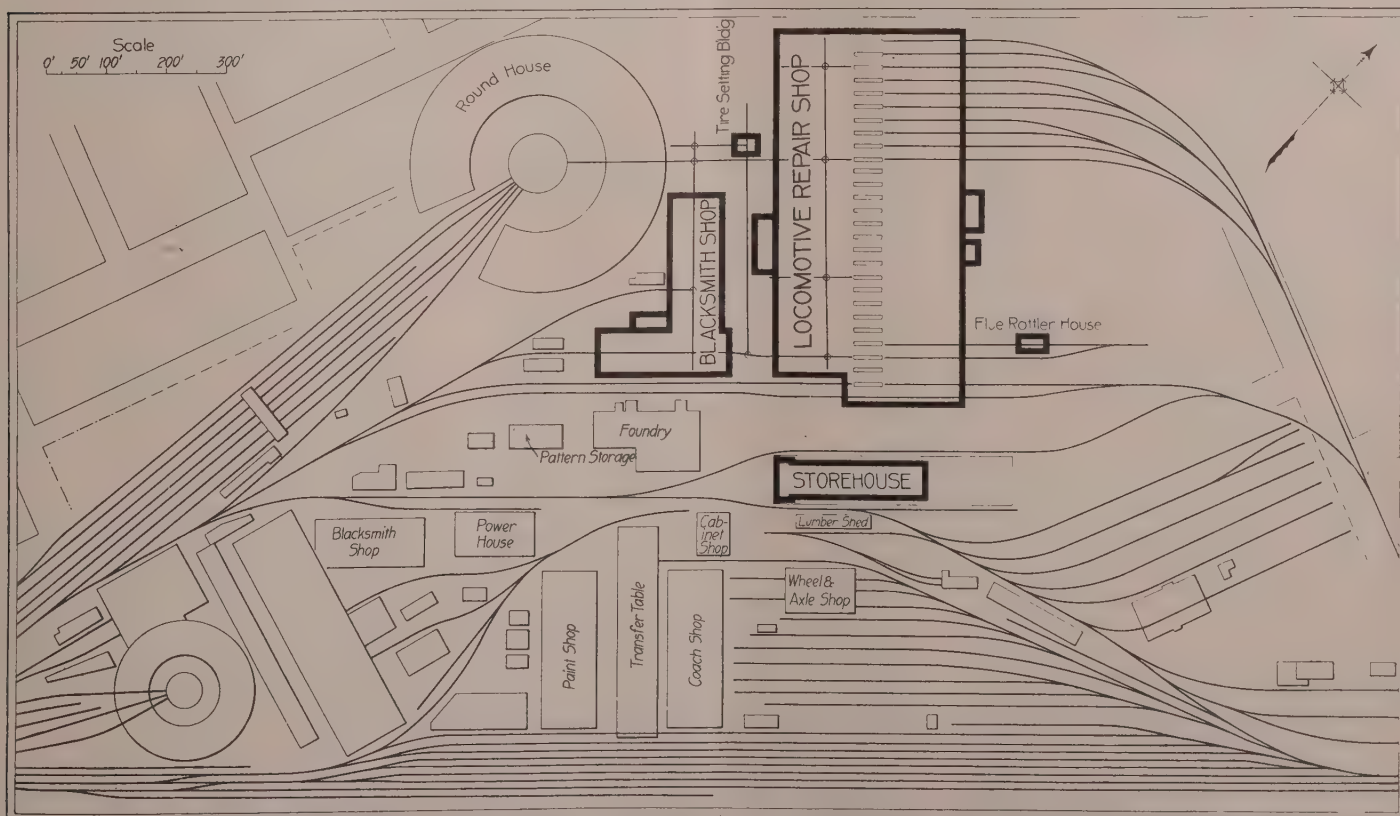
shop, machine shop and boiler and tender shop, the different departments having track connection with the various yard tracks and with the storage yards. The building is divided into five longitudinal bays, the central bay being 75 ft. wide and the four side bays each 60 ft. wide. In the central bay is located the erecting shop and in the side bays are the machine departments, the boiler shop, the tank shop and the necessary master mechanic's and foreman's offices, together with tool rooms and sub-store-rooms.

This building has a structural steel frame resting on concrete foundations, with side walls of concrete carried up to the window sills. Above the sills the building is of brick with the exception of the high walls of the erecting bay, which are of tile with stucco finish. The roof has wood purlins with 2-in. plank covered with prepared roofing. The floor in this building and in the tin shop consists of a 4-in. sub-base of tarred rock well rolled, covered with a 1-in. layer of sand and tar, in which is imbedded an underflooring of 3-in. yellow pine overlaid with a 1 1/6-in. maple floor. The building is exceptionally well lighted, the large window area of the side walls and the saw-tooth and monitor construction in the roof giving a lighting area of more than 28 per cent of the floor space.

The co-ordination of the various departments under one roof without partitions is an innovation in railroad shop layout, and admits of such an arrangement of tools that work and materials may pass through the shop in an orderly and progressive manner with the least possible rehandling.

ERECTING AND HEAVY MACHINE BAYS

The erecting bay is 75 ft. wide on column centers, with twenty-eight pits. It is served by two traveling electric cranes on two levels. The crane for the unwheeling of locomotives, located on the upper run-



IN ADDITIONS TO CAR-REPAIR SHOPS AT BLOOMINGTON ALL LOCOMOTIVE FACILITIES ARE IN ONE LARGE BUILDING

way, is of 150 tons capacity, and is equipped with two trolleys of 75 tons capacity, while the lower runway carries a 10-ton messenger crane. On every alternate column between the erecting pits jib cranes are provided for handling materials on the front ends of the locomotives.

Adjoining the erecting bay to the south is a 60-ft. bay in which are located the heavy machine tools, served by a 10-ton traveling crane. Still further south is another 60-ft. bay, in which are placed the lighter tools. The heavy tools are all equipped with individual motor drives, while the lighter ones are arranged in groups driven by motors of from 20 to 25 hp.

On the north of the erecting bay are two 60-ft. bays for the boiler and tank work. These two bays are served by traveling cranes, one of 15 tons capacity and the other, in the boiler assembling bay, of 40 tons capacity, equipped with two trolleys.

The hydraulic riveter is centrally located

State-Wide Survey Locates Road-Making Materials in New York

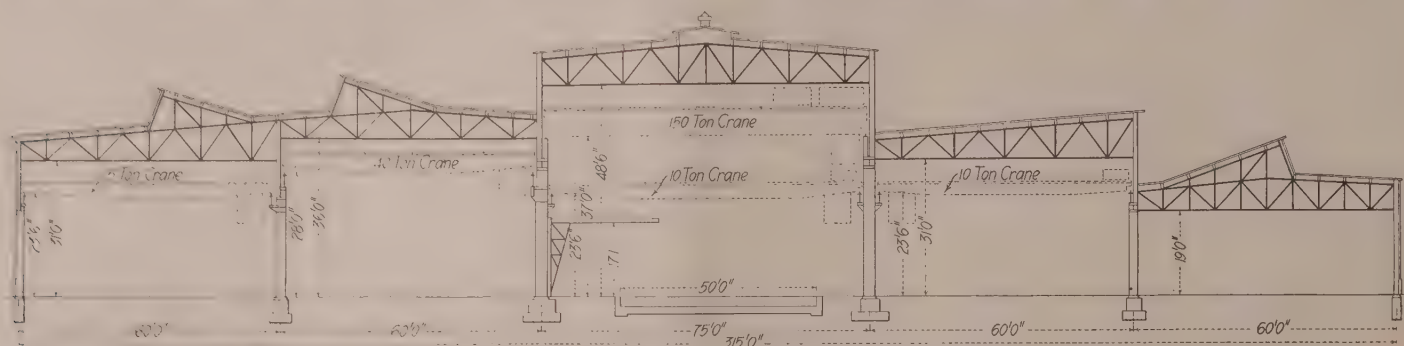
Information as to Stone and Sand, Plotted on Topographical Map, Facilitates Selection of Routes and Types of Pavement Prior to Letting Contracts

THE deputy commissioner of the New York State Highway Department was recently planning to advertise certain contracts for new construction. The traffic in the section under consideration was fairly well known and it was desired to build a concrete road, but there was some doubt as to the feasibility of securing local material sufficient in amount and quality for this type of construction. Scribbling a few lines on a scratch pad the commissioner sent to the testing laboratory in the basement of the department headquarters at Albany a memorandum asking for information on this important point. In a few minutes there came back to him a report indicating

of such proportions the importation of road-building materials is out of the question, and the engineers must know, prior to the letting of contracts, where suitable sand and stone can be secured locally. This information is now a matter of record as the result of the survey. So much depends on the character of the materials that hundreds of specimens are tested at the Albany laboratory, and the results are ready for reference whenever a call for this information is made.

EVERY LEDGE EXAMINED

The investigations are often begun a year or so before the road is to be built. A



THE FIVE BAYS OF THE NEW LOCOMOTIVE SHOP AT BLOOMINGTON ARE SERVED BY FIVE TRAVELING CRANES

in the boiler shop, with a tower constructed especially for it, and is served by its own 25-ton crane.

The shop is heated by an indirect blower system located in two specially constructed rooms built outside of and immediately connected with the main walls of the shop, and situated one on either side of the building about midway of its length. The artificial lighting is done by Tungsten nitrogen-filled lamps in 400-watt units.

BLACKSMITH SHOP

The blacksmith shop is similar to the locomotive shop in type of construction. It is an L-shaped building 80 ft. wide, one wing being 200 ft. and the other 300 ft. long. In the 200-ft. wing are assembled all the steam hammers ranging from 300 to 6000 lb. and in the 300-ft. wing all the forges and small power tools. The roof trusses on the 200-ft. wing are 10 ft. higher than those in the other wing, due to the 30-ft. headroom required to accommodate the jib cranes and hammers.

In the general design special care was taken to provide a layout that would afford opportunity for an orderly progression of the work through the shop and ease and economy in transporting materials or parts to the point of final use in the locomotive shop, with which it has suitable track connection.

The shops and layout were designed and constructed by Westinghouse Church Kerr & Company, of New York and Chicago, acting in co-operation with H. T. Douglas, Jr., chief engineer, and J. E. O'Hearne, superintendent of motive power of the Chicago & Alton Railroad, the actual field construction being in charge of P. J. Watson, assistant engineer, Chicago & Alton Railroad.

that stone suitable for concrete aggregate could be secured at Station —, within easy hauling distance, and that an abundant supply of sand was obtainable at Station —. The sand in its natural condition, when made up into concrete cubes and broken, showed a low strength but when washed, according to the report, it gave results which were entirely satisfactory. The decision in favor of a concrete road was made forthwith, and the contract was prepared on this basis. Here, then, was a convincing demonstration of the value of the State-wide survey of road making materials which the New York Highway Commission has recently been making.

EXPLORING STATE FOR SAND AND STONE

The area of New York has been explored for sand and stone with the same thoroughness that is used in sounding the depth of water in an important harbor, and charts have been prepared showing at a glance the location and character of the road-building materials available throughout the State. With these maps at hand the engineers of the highway commission have no more difficulty in selecting the type of road best suited to each locality than has the pilot of a ship in following a channel marked by bell-buoys.

The extreme importance of this information is apparent when it is realized that the New York State Highway Commission will expend on new routes during the coming season the sum of \$10,000,000. The magnitude of its operations is indicated by the fact that last year it used for road construction and auxiliary work almost 1,000,000 bbl. of Portland cement or about 1 per cent of the entire cement production of the United States. Obviously with a program

tentative route is supplied by the division engineer, and then a representative of the testing laboratory sets out on a tour of inspection. He examines every ledge and outcrop, sand-bank and stream and gets all information possible from the residents in the locality. The farmers often supply data of considerable value. Samples of the material are then taken at what appear to be the most promising places and are sent to Albany for test. It is not possible for the testing laboratory force to visit every route, and to some extent the examinations of the material in the field and the taking of samples are done by the division engineers or their representatives.

At the laboratory each sample of stone is given a number and subjected to the American Society of Testing Materials tests for abrasion, hardness and toughness. The specific gravity and absorption also are determined.

For concrete roads the aggregate must have a suitable coefficient of wear determined by the Deval abrasion machine. At the same time the hardness and toughness values have to be considered.

If a stone proves acceptable its location is plotted in black ink on one of the topographical maps of the U. S. Geological Survey, of which a complete set for the State is kept in a bound volume for this purpose. The same routine is followed in the case of samples of sand, the location of the sand-banks being marked on the topographical sheet in red ink.

SAND TESTS IMPORTANT

The experience has been that a mere visual inspection of sand gives no indication of its suitability as a fine aggregate for concrete. Many of the sands which

have been selected by experienced members of the highway department by general appearance and "feel" have proved by test entirely unreliable. The grains may be too fine or they may be coated with some mineral or clay covering which is not readily detected and which apparently destroys the bond in the concrete. For this reason no

On the road material survey the topographical maps of the U. S. Geological Survey have been a great help. All of the existing and proposed routes are indicated on these sheets and as soon as sand or stone of acceptable quality is discovered its location is marked, black ink being used for stone and red ink for sand. The sheets are

to the testing laboratory and spends a few days familiarizing himself with this important feature of the road problem. In this way he is made to realize how co-operation between the laboratory and the field men will further the success of road construction.

Shrinkage of Concrete and Conditions of Curing

Final Dimensions Prove to Be Same After Various Treatments During Aging, Although Strength Is Greatly Affected

By F. R. McMILLAN

College of Engineering, University of Minnesota

ALTHOUGH it is generally understood that the strength of concrete is directly affected by conditions of curing, the results of various methods of treatment during the aging of concrete upon shrinkage and final dimensions are not often considered. The series of tests here reported were extended over a period of about thirteen months and show that moisture during the early stages of curing only retards the shrinkage, the final dimensions being practically independent of early curing conditions.

SMALL BEAMS WERE USED

The beams tested were 4 x 5 in. in section and 48 in. long. They were cast from a single batch of 1:2:4 concrete composed of a local (Minneapolis) sand and crushed limestone and a standard grade of Portland cement. The beams were left covered with wet burlap for the first three days, after which the measurements of shrinkage were begun. These measurements were made with a Berry strain gage on gage lines formed by drilling into small steel plates set flush with the surface of the concrete before it had hardened. The beams were left standing on a slate slab and readings on the upper side only were taken.

Standard 8 x 16-in. cylinders were made

8-13-14-5000 (25-18204)

Form BR.-41

STATE OF NEW YORK

Rep. Cont. No.....

Commission of Highways

Highway No.....

Bureau of Tests,

Albany, N. Y.

Gentlemen:—I have this day shipped 2 concrete cubes. Mix:.....x.....x.....

Coarse aggregate is.....from property of.....
(Gravel or Broken Stone)

....., sand is from property of.....

cement used is..... This concrete used in.....
(Give Trade Name)

..... Concrete mixed.....191.....
(Date) Engineer in Charge.

THE FIELD ENGINEERS SEND TO THE TESTING LABORATORY POSTAL CARDS GIVING DETAILED INFORMATION REGARDING SAMPLES OF CONCRETE SHIPPED FOR EXAMINATION

sand is permitted to go into the construction of a road until it has been subjected to crushing tests in 2-in. cubes.

The sand-cement cubes are made in the proportion of 1:3 by volume, and for each sample eight are cast, four of natural sand and four of washed sand. There are also made with the same blend of cement eight cubes of standard Ottawa sand. These cubes are crushed at the end of seven and twenty-eight days and the results transmitted to the division office. Some marked discrepancies in strength are apparent between the washed and unwashed sand. A sand wholly unsuited for concrete in its natural state in some cases becomes an excellent fine aggregate, when its impurities have been removed.

For concrete pavement work not more than 20 per cent of the sand shall pass a 50-mesh sieve and not more than 6 per cent shall pass a 100-mesh sieve. The amount of loam must be less than 5 per cent and the compressive tests shall equal those of cubes made with the standard Ottawa sand. If these conditions are fulfilled the material is considered acceptable.

Less rigid requirements are made for concrete to be used in foundations for pavements or in culverts. Without the sanction of the testing laboratory no materials may enter into the construction of roads in New York State.

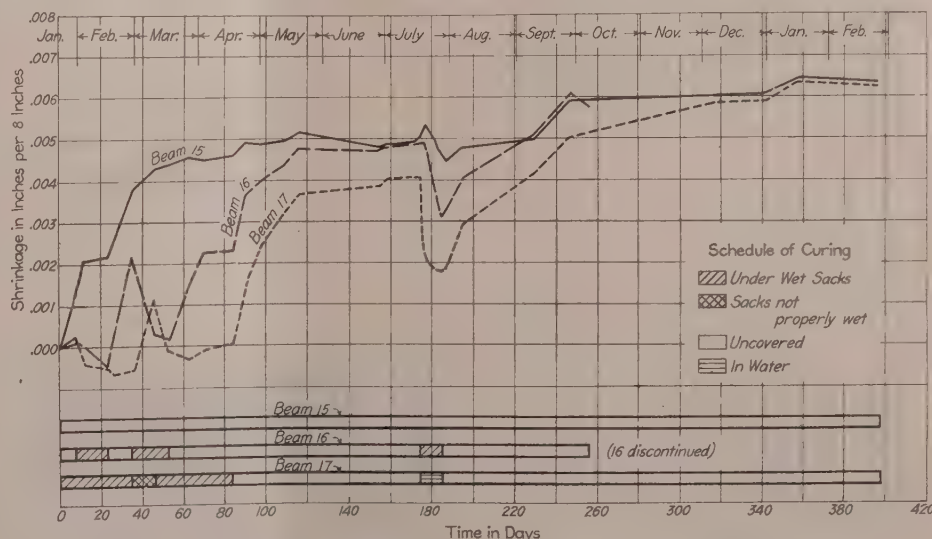
FIELD TESTS OF CONCRETE

As a supplement to the laboratory tests field tests of the concrete are made as the work progresses. Two 6-in. cubes for each 500 cu. yd. of concrete are made up of samples of material taken from the concrete mixer in place. These cubes are stored on the job in moist sand for twenty-one days and then sent to the laboratory and tested at the end of twenty-eight days. The requirements are a crushing strength of 3000 lb. per square inch for 1:1½:3 mix. The accompanying form is filled out at the division office and mailed to Albany, so that the complete record of the materials in the test tubes is available.

bound in heavy covers and form a permanent record of where road-building materials may be found. They are useful, not only in preparing contracts and giving information to prospective bidders, but serve also after the road has been in service and when repairs become necessary.

COUNTY ENGINEERS WITNESS TESTS

A particular effort is being made by the New York State Highway Commission to impress upon its field men the importance of laboratory tests. Last winter many of the county engineers spent a short while



EFFECT OF TIME AND METHOD OF CURING ON SHRINKAGE OF CONCRETE

at the laboratory learning of the methods used for examining sand and stone. One experiment seemed to impress these men strongly. Half a dozen jars of sand were placed before them and they were asked to select the material which in their judgment would make the best concrete. The material was then tested and the results compared. Whenever a new man is now ready to go out into the field he is first sent down

from the same batch of concrete as the beams for compression tests. Two cylinders were cast to correspond to each beam, and were cured in the same manner except for the re-wetting at the end of 175 days, which was not given to the cylinders.

The difference in curing conditions can be seen in the accompanying figure, which shows also the results of the shrinkage measurements. It will be seen that one

beam was left open to the air from the beginning, one was kept covered with wet burlap sacks for a period of twelve weeks, and the third alternately covered and uncovered for this period. From this time until the re-wetting at nearly the 180th day they were all open to the air, and again after the re-wetting all except beam 16 were under the same conditions to the end of the test. Beam 16 was taken away for other purposes after 260 days. It will be noted that at about the 180th day beam 17 was actually immersed in water, while beam 16 was only covered with wet burlap.

The results of the shrinkage measurements are plotted for the different days on which observations were taken to the scale indicated on the drawing. One of the spaces, representing a shrinkage of 0.001 in. in an 8-in. length, corresponds to a movement of 0.15 in. for 100 ft. From this it will be seen that the total shrinkage in these beams is equivalent to 0.95 in. per 100 ft.

One feature that will be observed from these curves is the rapid change in the concrete that takes place with the change in moisture conditions. This is shown not only by the rise and fall in the curve for beam 16, but in the break in the curve for beam 17 between the fortieth and forty-eighth days, when the sacks were not properly wetted. This is also shown in the ready response to the wetting at the advanced age. At this time it will be seen that beam 15, which was not covered, swelled somewhat. This was probably due to the sacks from beam 16, which stood close by, coming in contact with it.

TOTAL SHRINKAGE SAME FOR ALL

The most interesting and probably the most important result of these tests is the fact that independent of the treatment given the beams the final total shrinkage is the same in all cases. This seems all the more significant in view of the fact that the results of the compression tests show a marked difference in the strength. The cylinders cured the same as the beams, except for the re-wetting of beams 16 and 17 near the 180th day, showed the following results when tested at the age of one year, each value representing the average of two cylinders.

Cured open to air.....	1710 lb. per square inch
Cured alternately covered and open	1815 lb. per square inch
Cured covered for 12 weeks then open to air.....	2550 lb. per square inch

This shows that while the better curing conditions did not affect the total shrinkage it did increase the strength about 50 per cent.

GROSS OPERATING REVENUES for January on the large steam railroads of the United States, according to a bulletin issued by the Bureau of Railway Economics, were \$936 per mile, showing a decrease of \$85 or 8.3 per cent as compared with January, 1914. Operating expenses were \$716, a decrease of \$79 or 10.0 per cent. Net operating revenues, therefore, were \$220—a decrease of \$6 or 2.4 per cent, and operating income was \$171—a decrease of \$5 or 2.8 per cent. The operating ratio was 76.5 per cent, as compared with 77.9 per cent in 1914. Considering the three main districts, the respective ratios for January, 1915, and January, 1914, were as follows: Eastern district, 80.7 and 83.8; Southern, 74.2 and 74.4; Western, 72.8 and 72.9.

Small Automobile Opens Up New Opportunities in Government Stream Gaging Work

On U. S. Geological Survey Work Marked Economies Are Made in Cost and Time of Collecting Stream-Flow Data

By E. A. PORTER

District Engineer, Water Resources Branch, U. S. Geological Survey

BY using small automobiles instead of horses the water resources branch of the U. S. Geological Survey has been able to make surprising reductions in one of the items of greatest expense in connection with the collection of stream-flow data—transportation. The motor vehicles have proved particularly valuable in the Western States where the field is sparsely covered by railroads. Few daily trains are operated over these lines, so that the field engineer may be greatly delayed while traveling from point to point. Many of the gaging stations are far from railroad centers and transportation must, therefore, be arranged to and from such points at an average cost of probably not less than 20 cents a mile. In an endeavor to reduce this expense as much as possible authority has been granted from time to time by the Secretary of the Interior and by co-operating officials to purchase automobiles for use in the work.

The Federal funds available for stream measurement work have been insufficient for all the work to be done, so that an essential factor in the use of automobiles for stream measurement work is in the selection of a car that will cover the field in a satisfactory manner and that can be operated at a minimum cost.

The extensive use of the Ford car by other Government departments, and by private concerns, municipalities, and various professional men, has led to the establishment of a large number of Ford agencies and supply stations throughout the United States. Facilities for the operation of this car are, therefore, exceptionally good.

OPERATING COSTS

In the Engineering Record of September 9, 1914, page 331, George W. Batchelder gives cost data for the operation of automobiles in the water department of Worcester, Mass. (See Table 1).

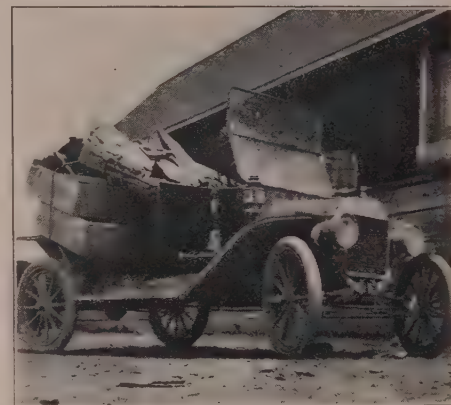
Table 1 indicates that the Ford automobile is more economical to operate than the other machines mentioned, and experience has proved that this car is strong

and powerful enough to give the service required in the stream-measurement field.

The operating costs of Ford cars, including depreciation, used by the water resources branch of the U. S. Geological Survey for stream measurement work are shown in Table 2.

AUTOMOBILES VS. HORSES

The cost of transportation is especially high where the field engineers are compelled to depend on horses and, moreover, the time consumed is much greater. The average distance that can be covered daily by horses throughout the Western States is not more than 25 miles, whereas the



CAR LOAD FOR STREAM-GAGING TRIP IN SOUTHERN UTAH

daily average of a Ford automobile over the same territory is conservatively estimated at 60 miles. The importance of this fact is obvious in connection with the element of time that enters so largely into the results of the work of the field

TABLE 1.—COST OF OPERATING AUTOMOBILES IN WATER DEPARTMENT, WORCESTER, MASS.

Car No.	Make	Yearly operating cost
1	Buick, two-cylinder	\$1,048
2	Buick, four cylinder	1,200
3	Buick, model 21	1,290
4	Pope-Hartford, four-cylinder	1,280
5	Pope-Hartford, model 31	1,262
6	Pope-Hartford, 3-ton truck	(See note)
7	Ford runabout	291

Note.—Car 6 was operated at a cost of \$13.86 a day. Cost of team-work for same class of work, \$38.50 a day.

Car 7 did the work of two horses.

engineer, whose principal duty is to make discharge measurements at a great number of gaging stations situated on adjacent streams the actions of which are analogous; for it is usually impracticable to have several engineers in the field at the



HOW THE EQUIPMENT IS PACKED ON BACK OF CAR

TABLE 2.—OPERATING COSTS OF FORD AUTOMOBILES USED IN STREAM MEASUREMENT WORK

Location of car	Miles in travel	Total cost	Cost per mile
Arizona	No data	No data	
California	24,000	\$1,440.00	6.0 cents
Hawaii, two cars, No record	No record	No record	*5.0 cents
Nevada	10,500	\$1,183.72	11.2 cents
New York	40,000	*1,380.00	4.7 cents
Utah, No. 1	8,270	700.30	8.5 cents
Utah, No. 2	2,180	266.00	12.2 cents

*Approximate.



CAR USED IN NEVADA HAS STORAGE CHEST FOR FIELD EQUIPMENT

same period, and one engineer is expected to cover a large territory.

The engineer's transportation outfit for stream measurement work, usually requires two or more horses, a light but strong buggy, a set of good harness, and other minor supplies. In the Western States the cost of such an outfit varies from \$375 to \$500, with heavy depreciation charges and probable death of horses through sickness or injury. The expenses incident to the feed and care of the outfit vary from \$1.00 to \$2.50 a day. The team will do well to travel 2,500 miles a season.

Table 3 shows the results of the comparison of data obtained by careful study of conditions encountered in the field served by Utah car 1.

TIME SAVED BY MACHINES

The most striking element of the comparison is the time consumed by the automobile and double team of horses. The field engineer required 129 days by use of the automobile, which left 70 days to be devoted to office work, Sundays, etc. With a team 230 days would have been required—31 days more than were available. To complete the work with one team in 230 days the engineer would have

to be on the road every day during the season. Furthermore, a drive of 2,500 miles a season would probably have been the limit for the team. Two men, each driving a double team, could have covered the field and probably have made more discharge measurements, but the expense per measurement would have been greater.

In the State of Nevada the cost of travel per mile, in stream measurement work, using horses will probably not be less than 25 cents per mile, and the average number of miles traveled per day for the season will probably be about 25. Sixty miles per day for a Ford automobile is a conservative estimate, for the Nevada roads are as a rule good.

CONCLUSIONS AND SUMMARY

Conditions in Montana, Wyoming, Colorado, Idaho, Arizona, New Mexico, and central California will not vary greatly from those in Utah and Nevada, and the cost of operating a Ford car will hover about the maximum. In southern California, and in New York and other Eastern States, the operative cost should fall to a minimum. In the middle Western States

reduce to a minimum the chance for accidents, and to secure accommodations which enable him to put gaging stations in first-class condition. The car can accommodate one or two extra men and thus affords an inspecting officer every opportunity to save time and money in a review of the field work.

The following changes should be made on the car before using it for general field work.

1. Arrange wheels to use 3½-in. over-sized tires all around; rear tires should have irregular surface and not smooth tread.

2. Install a master vibrator in order to increase the efficiency of the ignition system.

3. A good speedometer is desirable.

4. Add a hand Klaxon horn. The bulb horns are practically worthless.

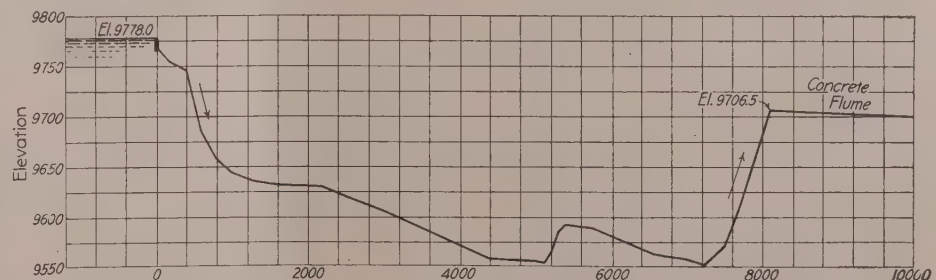
5. Radius rod braces should be used.

6. In isolated regions add a chest to the rear of the car with compartments for the accommodation of the engineer's field equipment and 15 gal. of extra gasoline. In Nevada, gasoline can be purchased along the main railroad lines for about 25 cents per gallon; 100 miles to the interior the cost will be as high as 40 cents per gallon.

Half-Ton Stone Goes Up Steep Grade through Pipe Line

ENGINEERS on the Santa Maria irrigation project, near Creede, Cal., were recently somewhat surprised to find a large stone weighing about half a ton calmly reposing in a concrete flume 100 ft. from the downstream end of a 48-in. wood-stave pipe line 8125 ft. long, through which the stone has passed. The unwieldy visitor's journey was rendered all the more remarkable in that it had been pushed up 850 ft. of 18-per cent grade. Its form was somewhat wedge-shaped and measured 2 ft. long, 1.8 ft. wide and 1.8 ft. high. The stone was broken up and removed from the flume. How the stone got in the pipe is unknown, but the belief is that it slipped in at some time when repairs were being made at the head works.

The Engineering Record of Oct. 12, 1912,



A BROKEN PROFILE THAT INCLUDED AN 18-PER CENT GRADE DID NOT PREVENT A HALF-TON STONE FROM MAKING AN 8000-FOOT JOURNEY THROUGH A 48-INCH PIPE

this cost will no doubt be more than in the last group of States and less than in the first group. In Oregon, Washington, and northern California conditions of climate and roads probably do not at present warrant the use of an automobile in stream measurement work.

The data indicate that the small automobile is more efficient in stream measurement work than a team. For long trips away from railroad centers it allows the field engineer to increase largely his average mileage, to cut costs of operation and

page 396, contains a complete description of the construction of the Santa Maria Lake dam, for which T. W. Joycox was consulting engineer.

O. F. DALSTROM, chief draftsman of the bridge department of the Chicago & North Western Railway, was the author of the article "Substructure Conditions Fix Design of Chicago & North Western Bridge at Pekin," published in the Engineering Record of April 3, page 425. His name was incorrectly given as F. C. Dalston.

TABLE 3.—AUTOMOBILE AND HORSE TRANSPORTATION COMPARED

Items of work	By automobile	By two-horse outfit
Actual distance necessary for season's field work	6,403 miles	5,438 miles
Actual time available (including Sundays) April 15 to Nov. 1, 1914	199 days	199 days
Actual time consumed for season's field work (April 15 to Oct. 31, 1914)	129 days	230 days
Time allowed field engineer for office and other work	70 days	minus 31 days
Actual average distance traveled for season per day	50 miles	24 miles
Actual number of discharge measurements for season	298	298
Number of measurements per mile	.047	.055
Salary and expenses of one field engineer for season at \$5.35 per day	\$1,064.65	\$1,230.50
Cost of transportation for season by auto at 8½ cents per mile; by 2-horse team and buggy at \$4.50 per day	544.26	1,035.00
Salary and expenses of two field engineers, at \$10.35 per day*		2,059.65
Cost of transportation for season, 2 teams, at \$4.50 per day*		1,791.00

*Based on assumption that one engineer and team could not cover the field; two men and teams would be required.

Low River Flow Exacting for Columbus Sewage Works

Annual Report Indicates 1914 Natural Conditions Most Adverse Since Starting Plant—Septic Tanks to Be Converted Into Imhoff Tanks

NATURAL conditions in the Scioto River below Columbus, Ohio, in 1914 were the most exacting since the sewage treatment works have been in service, according to the annual report of C. B. Hoover, chemist in charge. From June to November the river discharge was less than 50 sec.-ft., with a minimum of 8 sec.-ft. At the same time the mean dry-weather flow of sewage was 30 sec.-ft., of which only 78 per cent were pumped to the treatment works because of insufficient capacity and lack of funds.

During the latter portion of the year the steam units were abandoned for motor-driven centrifugal pumps operated with current from the municipal electric light plant. The combined capacity of the new units is between 45,000,000 and 50,000,000 gal. daily against a head of 40 ft. The change reduced the payroll \$6000 per year. As the average cost of current will be less than 1 cent per kilowatt-hour, an additional saving for power may be obtained.

On account of insufficient funds the treatment plant was in operation during only a part of the year, from April 20 to Nov. 16. Plenty of water for diluting the raw sewage was available in the river during the remainder of the year and low winter temperatures still further reduced the probability of the production of a nuisance.

COMPOSITION OF SEWAGE

During the year the sewage was of average composition as indicated in the table. The septic tanks were in continuous service for an average period of 22 days and the average storage period was 4.7 hr. The tank treatment resulted in the removal of 60 per cent of the total suspended matter of the raw sewage which averaged 260 p.p.m.

The dissolved oxygen demand was not reduced by tank treatment to the same extent that the total suspended matter was, and the actual percentage reduction values for the dissolved oxygen demand and the total suspended matter were 60 and 25 respectively.

The partially digested sludge from the septic tanks was flushed into the lagoons which have been in service for the past three years and which are practically no longer available for this purpose. These lagoons were not a part of the original plan of sludge treatment, but were pressed into service at a later date and with the

idea of serving only temporarily for this purpose.

MOTHS INCREASE FILTER EFFICIENCY

The sprinkling filters gave better service in 1914 than in the previous year. There was an abundance of moth flies in the filtering material and only a slight removal of suspended matter by the sprinkling filters. During the previous year there were very few moth flies and a very considerable removal of suspended matter by the sprinkling filters. The function of these lower forms of life other than bacteria, has not been given the study which it appears might be quite profitable in view of the apparently useful service which they perform in the disposal of organic deposits in the filtering beds.

The effluent from the sprinklers, in comparison with the results of previous years, was well nitrified and showed a fair stability value and a low dissolved oxygen demand. The purifying agencies in the beds

accurate method of determining the dissolved oxygen.

Plans have been completed for converting the present septic tanks into Imhoff tanks, the construction of sludge drying beds, and the installation of automatic dosing equipment for the sprinkling filters.

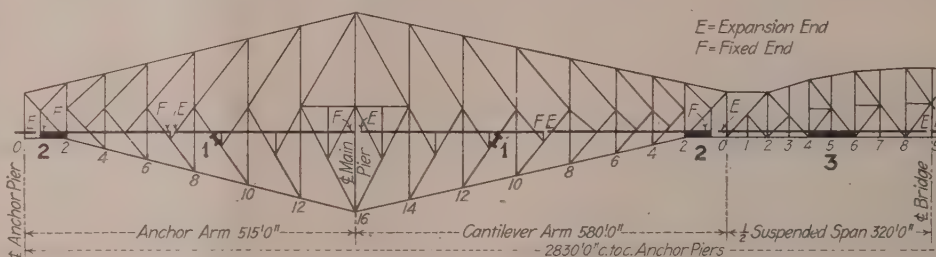
Provision for Traction Stresses in Quebec Bridge

Three Types of Trusses Used to Transmit Longitudinal Forces to the Main Trusses and Bracing at Ten Points

By C. A. NORTON

Formerly in Designing Division, St. Lawrence Bridge Company, Montreal

ON ACCOUNT of the necessity to provide expansion joints in the floor system of the Quebec Bridge, special methods had to be devised to take care of the traction stresses. These stresses, while not



LOCATION OF THREE TYPES OF TRACTION TRUSS FOR QUEBEC BRIDGE

seem to have been more active this year than last, but the reasons for this are not evident. The question naturally arises as to whether the activity of these agencies is governed by conditions which are within or beyond control. This is a problem in the field of practical sewage treatment, stated Mr. Hoover, which is worthy of considerable research. It seems probable that at least some of the conditions which stimulate the life and activity of these lower organisms might be supplied.

The river tests during the past year have been more comprehensive than in the past and have included observations relative to odor, color, gasification, floating material of sewage origin and stream bed deposits of sewage origin, in addition to determinations of temperature, dissolved oxygen and dissolved oxygen consumed.

Average results for the years 1913 and 1914 with respect to the saturation of the river water with dissolved oxygen, seem to show that the river was in worse condition this year than last, but this probably is not true as the averages for 1913 were increased by supersaturation values which were not found this year because of a more

large, comparatively, were found to be somewhat difficult to transmit in an efficient manner to the main truss members. The fact that the bridge is built on a 1-per cent grade on both sides to the channel span does not make the effect of traction any the less real.

Considering the bridge as a whole between anchor piers, the fixed points are at the main piers and all tractive forces must of course be finally transmitted to them. Large movements in the floors have therefore to be provided for near the ends of the anchor and cantilever arms. Intermediate floor expansion joints are located so as to divide the anchor and cantilever arms and the suspended span each into two sections, making ten sections in the total length of 2830 ft. The traction devices for each of these sections are proportioned according to the length of section, assuming 750 lb. per linear foot of track. The expansion joints and location of the traction trusses are indicated on the elevation of the main trusses in the accompanying figure.

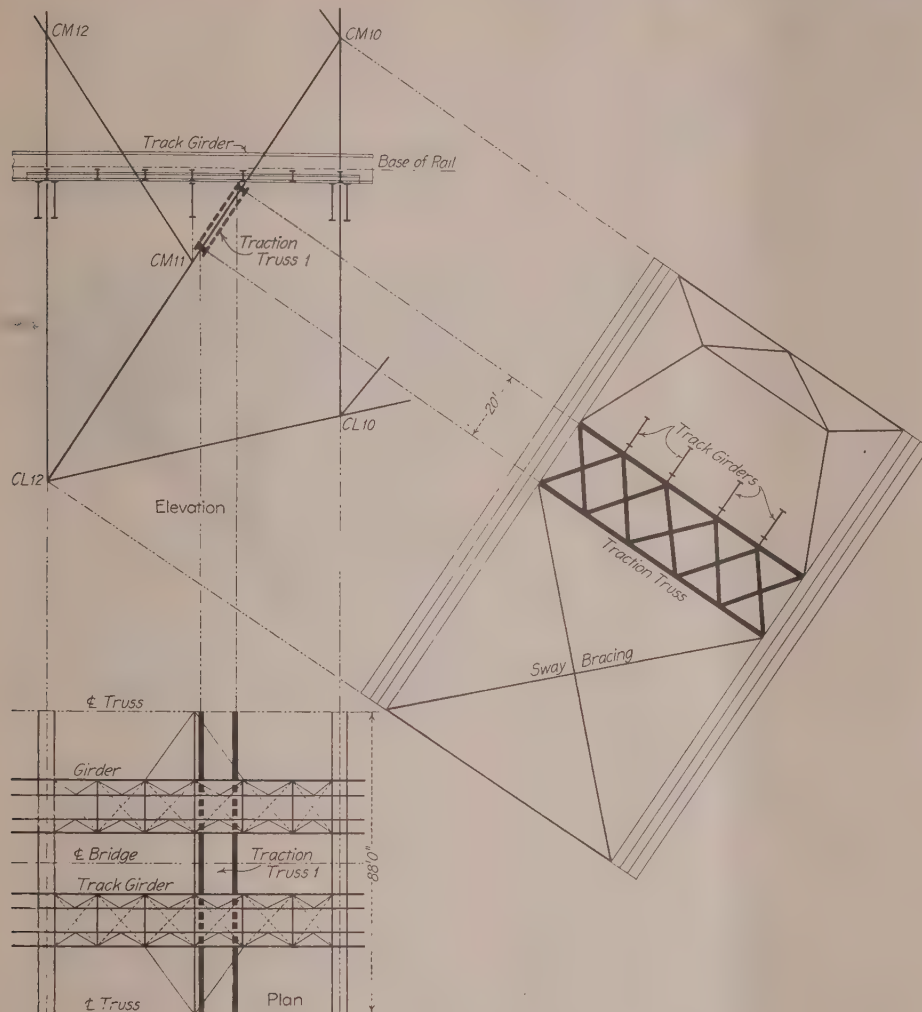
TWO GENERAL TYPES OF TRACTION TRUSSES USED

These floor sections may be divided into two classes. In one, consisting of the floor for the suspended span and the outer halves of the anchor and cantilever arms, the base of rail is near the bottom chord so that the traction girders may be connected directly to the bottom laterals of the main trusses; in the other, comprising the sections nearest the main posts, the floor is far above the bottom chords, so that tractive forces have to be transmitted first to diagonal web members.

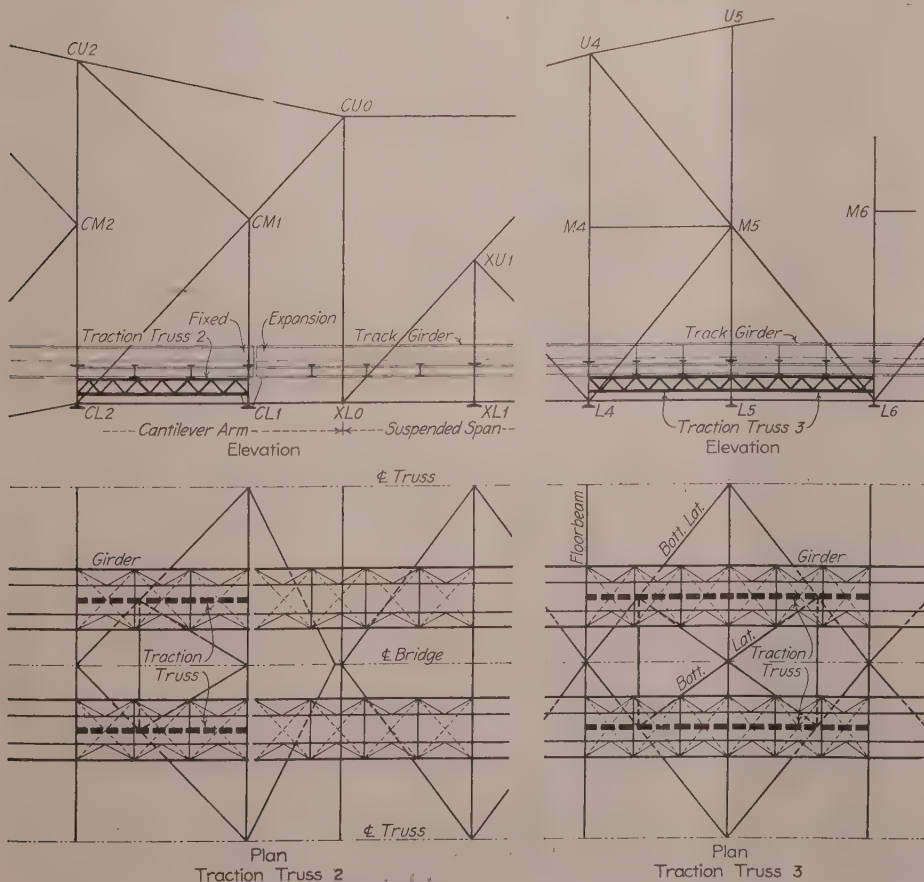
In the first class above noted latticed girders spanning the panel length in which the traction is taken are placed on the center line of each of the two tracks below

ANALYTICAL SUMMARY, COLUMBUS SEWAGE TREATMENT WORKS

Year	Parts per million								Nitrogen as Nitrites and Nitrates	Dis- solved Oxygen	Per cent Satur- ated	Stability value
	Suspended Matter				Dissolved Oxygen consumed in 24 hours at 37 Degs. C.							
	Raw sewage	Tank Eff.	Spkr. Eff.	Final Eff.	Raw sewage	Tank Eff.	Spkr. Eff.	Final Eff.	Final Eff.	Final Eff.	Final Eff.	
1908.	201	82	84	41	102	73	23	27	3.35	5.8	..	89
1910.	211	80	79	50	131	95	25	27	4.00	7.7	..	84
1911.	287	99	96	..	198	146	28	..	6.10	..	..	71
1912.	245	109	88	..	147	104	26	22	4.10	4.5	47	84
1913.	300	121	63	65	131	98	22	21	4.70	5.9	56	67
1914.	260	104	91	88	..	..	..	..	..	..	..	79



ARRANGEMENT OF TRACTION TRUSS 1 IN CANTILEVER ARM



TRACTION TRUSSES 2 AND 3 WITH CONNECTIONS TO LATERAL BRACING

the floor, so that their top flanges receive the traction stresses from the bottom lateral system of the track girders and their bottom flanges deliver these stresses to the main bottom laterals below, which are trussed to transmit them to the bottom chords. These traction girders, about 3 ft. in depth, are made stiff enough to provide also for the bending moments thus set up and to transmit them to the main floorbeams in the form of shear. The girders have a simple I-section formed by pairs of $4 \times 4 \times \frac{1}{2}$ -in. angles for the top and bottom flanges, which are connected by lattice angles to form a Warren truss. The accompanying outline sketches of trusses 2 and 3 indicate their relation to floor and lateral bracing.

In the second class of floor sections as mentioned above, traction is delivered from track girders in the sixth panel out from the main posts on either side. In these panels the plane of the diagonal post sway-bracing intersects the plane of the bottom chords of the track girders near the third point of their span at an angle of about 45 deg. A double latticed truss about 20 ft. deep, which is also part of the sway-bracing system, is placed so that its top flange is connected to the bottom flanges of the track girders by stiff brackets. This truss then receives stress from each girder and transmits it to the diagonal posts. The vertical component of the stress thus delivered to the traction truss at each connection is resisted by the track girder in bending, causing either an increase or decrease in the bending moment therein according to the direction of traction. The track girders and main floorbeams on which they are seated are proportioned to take care of these additional stresses. The accompanying sketch of truss 1 indicates the relation to floor and bracing.

Conditions in the anchor and cantilever arms were so nearly alike that the traction trusses for the two arms could be made identical. Each truss very closely resembles a portal brace. In form it is a double Warren type with five panels arranged to suit the four connections for the track girders. The top and bottom chords are I-shaped members formed by two pairs of angles separated by lattice angles and framed into the diagonal posts, which are 45 in. deep. The web members are made with two single angles similarly latticed.

SAND FOR THE FILTERS at Moline and Rock Island, Ill., is obtained from the Mississippi River by a centrifugal sand pump on a boat. Barges are unloaded at the dock into the river by a stream of water from the sand pump. From the river the sand is pumped again to the bins. "So much handling by water thoroughly washes the sand", said L. A. Fritze, city chemist of Moline, at the meeting of the Illinois Section of the American Waterworks Association. The raw product has an effective size of 0.28 mm and a uniformity coefficient of 2.11. By washing off the fine sand after placing in the filters the size is increased to 0.51 mm and the uniformity coefficient reduced to 1.34. Nine inches of large-sized gravel, 2 in. and over, placed under the regulation layer with from $\frac{3}{4}$ to $\frac{1}{4}$ -in. sizes, made the operation more satisfactory. In six months there were no packing or strainer troubles. The river sand ready for service costs \$1.47 per cubic yard.

Snow Survey Provides Basis for Close Forecast of Watershed's Yield

Rapid and Economical Methods of Measuring Large Areas of Snow at High Altitudes Prove Useful at Lake Tahoe, Nevada

By J. E. CHURCH, JR.

Director, Mount Rose Observatory, University of Nevada

IN THE SPRING of 1909, the staff of Mount Rose Observatory of the University of Nevada inaugurated a system of snow surveys over limited areas by following contour lines and making measurements of water content at regular and frequent intervals. Since that time, however, such surveys have been confined to typical slopes, for the purpose of investigating the larger problems of the influence of mountains and forests on the conservation of snow. This work has been carried on mainly in the basin of Lake Tahoe, in the heart of the Sierra Nevada Mountains.

The basin measures approximately 20 x 30 miles, the watershed extending 5 miles from the lake on every side except the south, where it extends 10 miles or more. The watershed rises at one point 4675 ft. above the level of the lake and has a mean elevation above it of 1275 ft. The slopes of the watershed are complex and the forest cover varies from dense fir to low manzanita and sparse sagebrush. The snowfall, which naturally varies with elevation, also varies greatly at similar levels.

LAKE'S LEVEL CLOSELY PREDICTED

In the spring of 1912, in a definite effort to determine the water content of the entire basin, one observer and assistant, by means of motor boat and explorers' camp, succeeded in a total of three week's work in obtaining sufficient data to enable L. O. Murphy, hydrographer of the Truckee River General Electric Company, which controls the outlet of the lake, to estimate within 0.1 ft. the actual maximum level of the lake for the following summer.

The result was made possible more by the instruments employed than by refine-

ment of method. The lightness and efficiency of the Mount Rose sampler and weigher, shown in the drawing, made ascents of 3000 ft. possible in a single day, with sufficient time en route to obtain from 50 to 60 measurements of depth and water content of the snow. The water content of a sample is determined by weighing the tube and its core upon a spring scale, the dial of which is ruled to indicate the depth of water instead of its weight. Rapid and complete measurements were possible under all conditions of depth and density, and so precise were the sampler and spring balance that both depth and water content could be determined to tenths of an inch. By thus combining precision with multiplicity of measurements the average snow on the ground in the immediate region could be accurately determined, irrespective of local peculiarities such as trees, brush, ravines, etc., or irregularities in water content due to drifts, hollows, and the uneven settling of the snow.

GENERAL METHOD PURSUED

The general method pursued was to determine the water content of the snow on typical slopes and under characteristic forest covers, making each topographic unit as large as possible. Measurements were made in sufficient sections of the basin to determine the local difference in snowfall, and enough courses at high levels were measured to determine the relation of the snowfall on the higher slopes of the watershed to that on the floor of the basin. The courses did not always follow contour lines but were frequently diagonal, and sometimes vertical to them, being so laid as to determine the water content of the slope in question. On occasions, courses have been laid for 2000 ft. or more directly up the face of a mountain, particularly when the rate of increase in snowfall with elevation was being determined. If avoidable, no course had less than 25 measurements and one had as many as 59. The distance between measurements was kept uniform. Thus the average of the measurements of any course could be taken as a fair representative of the average depth of the snow over the entire slope.

In the survey of the Tahoe watershed 33 courses were measured. Most of these were on the western side of the lake, where the snowfall is heaviest, and were distributed equally along the entire watershed from north to south, for the local differences in precipitation vary from 37 to 66 per cent between the center and the north and south ends. The snowfall on the eastern side of the basin is much lighter and required proportionately fewer courses. The highest course in the basin was at the elevation of 2775 ft. above the lake.

The courses were afterwards plotted on a topographic map and the average snow cover of the entire basin was computed from the known area of the region. The losses by evaporation were computed on the basis of losses as in previous years.

Measurements usually were made later

at the higher levels instead of on the floor of the basin, for melting begins there somewhat later than below, and the snow also continues to fall there somewhat longer.

The snow on the ground at the time of this survey was only 70 per cent of that found in 1910, a year nine-tenths normal. The maximum depth of snow found in the regular courses was 98 in. in 1912 and 129



PAN IN PERFECT CONDITION AFTER SNOW STORM

in. in 1910. Depths of 210 and 250 in., however, have been found at a few points in the basin.

ADVANTAGES OVER CONTOUR-LINE SURVEYS

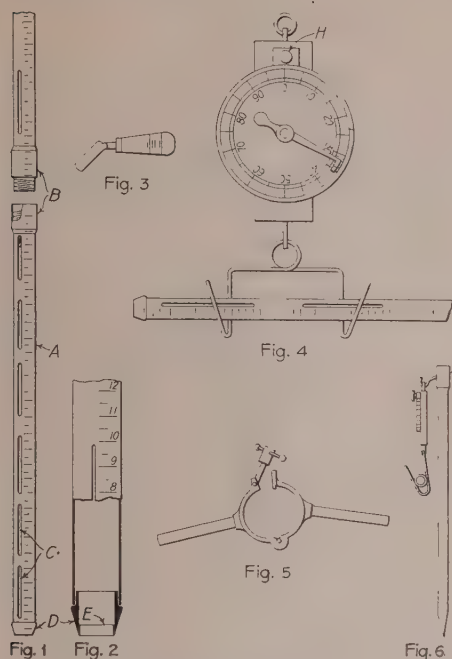
The advantages of the method of snow-surveying described are evident. It is a practical substitute for the method of contour-line surveying, which is too expensive to put into operation. It will greatly increase accuracy in estimating the water content of the snow over large areas and probably at no greater expense than required for the maintenance of isolated snow observers. The work also can be centralized in the hands of fewer and probably more capable observers. Although the presence of a lake in the basin measured made access to its various portions easier, most basins are accessible from some adjacent settlement that can be reached by the usual methods of winter travel. Considerable climbing on snow-shoes is necessarily involved, but with a sampler and weigher of sufficient range and lightness an ascent of 3000 to 5000 ft. can be made in a long day and time be left to make 50 or more deep measurements en route.

As the quantitative relationship between the snowfall at the higher levels and at the lower becomes better known, it may be possible to compute the actual snowfall at the higher levels from what might be called the symptomatic snowfall at the lower. The rate of melting and evaporation at the higher levels can also possibly be determined in like manner in terms of the weather. The data on these points, however, are thus far both meager and conflicting.

The survey of 1913 has demonstrated the general accuracy of snow surveying and the superiority of field work over routine measurements at a single station in the basin. Owing to delay in arranging co-operation with the interests using the waters of Lake Tahoe, the survey was not begun until April 11, when the snow at the lower levels was already partially melted. However, the survey at the higher levels was extended considerably beyond the lim-



THE TWENTY-FOOT SNOW SAMPLER



DETAILS OF SNOW SAMPLER USED IN LAKE
TAHOE BASIN

its of the survey of 1912. Thirty-one courses in all were measured and 725 separate measurements made, yet only two and one-half weeks were spent in the work.

The excess of snow (in water equivalent) over that of 1912 was approximately 30 per cent, the averages at four points in the basin being: Spooner's Ranch, 27 per cent (based upon depth only); Ward Creek, 33.6 per cent; Rubicon Park, 34.2 per cent; Mount Tallac, 32.6 per cent.

The rise in the level of Lake Tahoe over that of 1912 was only 0.35 ft. or 30.4 per cent, the accuracy of the forecast based on the snow measurements being thus well within that attained in 1912. According to the measurements made at eight stations of the U. S. Weather Bureau, the average precipitation of the entire basin at the level of the lake was 22.6 per cent greater than in 1912.

VALUE OF FIELD MEASUREMENTS

The value of field measurements over measurements at a single station is demonstrated by the fact that at Tahoe City, where is the principal snowfall station on Lake Tahoe, the local precipitation indicated an excess of 86.6 per cent over 1912, whereas the snow survey indicated an excess of only 33.5 per cent (including Spooner's, 31.9 per cent), or within 10.9 per cent of the excess indicated by the average of the measurements of precipitation at the eight stations of the Weather Bureau on the lake, and within 3.1 per cent of the level actually attained by the lake itself. Furthermore, the expense of the survey was considerably less than one-half of the amount necessary to maintain the eight stations. It is, of course, true that these stations furnish climatic statistics of precipitation, measured storm by storm, and of snow on the ground, measured month by month, which the snow survey, if restricted to the time of melting, cannot do.

The snow studies have been supported by a grant authorized under the Adams Act of the U. S. Office of Experiment Stations and the Nevada Agricultural Experiment Station.

Owing to the unusually heavy precipita-

tion at Lake Tahoe in 1914, the snow survey of the Tahoe Basin was made as early as February to forecast the level of the lake in abundant time to release the surplus water without flooding the ranch lands below. The level of the lake had already risen 2.2 ft. above the minimum in the autumn.

The relation of the water equivalent of the snow on the west side of the basin, where the heaviest precipitation falls, to that of 1913 was found to be as follows:

	RELATION OF WATER EQUIVALENT OF SNOW		
	1913, inches	1914 inches	per cent of 1913
North End	28.03	57.93	199.6
North Central	19.09	37.76	197.8
South Central	30.22	53.09	175.7
South End	22.27	44.35	201.4
Average percentage.....			193.6

The rise of the lake in 1913 (on the assumption that the gates were closed) was 1.5 ft. On this basis, the rise for 1914 should have been 2.85 ft., or 5.05 ft. above the autumn minimum, leaving a reserve of 0.95 ft. below the maximum level. Since February additional precipitation has fallen, amounting to 5 in., which with a subsequent rise of 0.2 ft. in the lake level, should make a total rise for the season of 5.5 ft., or slightly less, if allowance be made for increase in evaporation during the unusually clear weather of February and March.

1913-14 COMPARED WITH 1889-90

A rough check upon the present estimate is furnished by the season of 1889-90, when, as in 1914, the precipitation was unusually heavy and the run-off influenced by two dry years preceding. The precipitation for 1889-90 and 1913-14 appears from markings of snow level on the trees to be approximately equal. In the former season, the lake rose "one or two inches less than 5 ft." above its minimum level of the preceding autumn, or within approximately 0.5 ft. of the estimate of the level for the present season.

The assurance to the property owners on the lake that their lands would not be flooded and to the power companies and ranchers that their source of supply would be abundant fully justified the survey.

Decatur Installs Plant for Sewage Tests

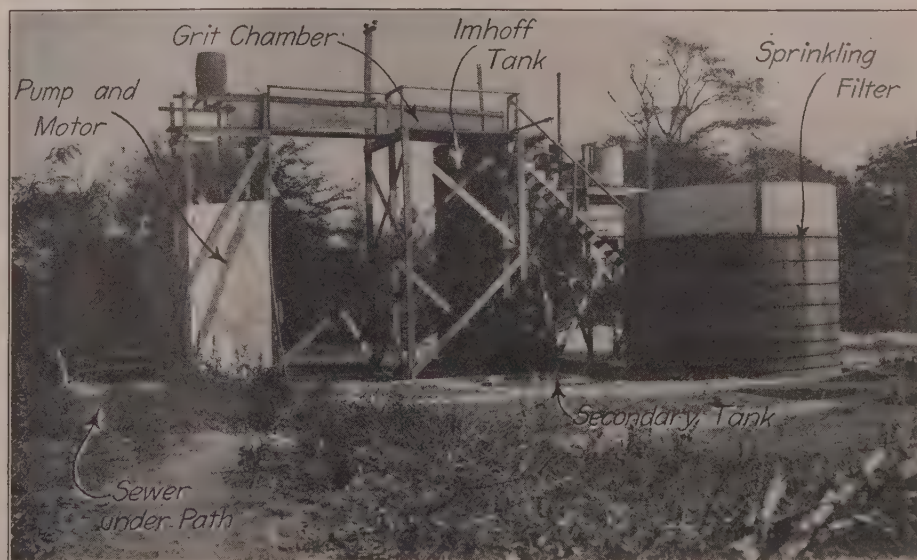
Small Experimental Station Built to Investigate Possibilities of Treating Sewage Containing Corn Products and Gas Works Wastes

A SIMPLE testing station for the study of the sewage in the Broadway sewer in Decatur, Ill., was put into service last September. Some of the points to be ascertained were the best method of grit removal, amount of sludge from sedimentation, and the rate at which a sewage containing industrial wastes from gas works and corn products establishments could be handled. At the outlet of the Broadway sewer, where the station is located, the dry weather flow is 1,500,000 gal. daily, an amount obtained from 1500 acres of territory. Analyses have shown that the biological oxygen consumed has been as high as 4600 parts per million.

PLANT

The plant comprises a coarse bar screen and grit chamber, an Imhoff tank, a sprinkling filter and secondary settling basin. A weir at the sewer mouth raises the level of the sewage sufficiently to permit pumping directly through the bar screen built up in the shape of a box having $\frac{3}{8}$ -in. openings between the $\frac{3}{8}$ -in. round bars. The 3-in. suction pipe connects with a $1\frac{3}{4}$ -in. Morris centrifugal pump, belted to a 3-hp Wagner motor. The discharge is into a barrel acting as a stilling box at the head of the grit chamber, 20 ft. long, $2\frac{1}{2}$ ft. wide, 2 ft. deep at the inlet end and 12 in. deep at the outlet end. At the nominal rate of pumping, 75,000 gal. daily, the velocity will be 0.44 ft. per second. The chamber is built of No. 24 galvanized sheet iron, soldered together and stiffened with 2 x 4-in. wood framing. The grit chamber feeds directly into an orifice box in which, by an overflow, a constant level is maintained. The discharge is into the inlet end of the Imhoff tank. An overflow orifice box is placed below the first box so that the total flow from the grit chamber is measured.

The double-deck Imhoff tank is 15 ft. $3\frac{1}{2}$ in. deep, and the two chambers are separated by baffles of No. 24 galvanized iron, carried on 2 x 4-in. framing. The bottom



TESTING STATION AT DECATUR, WITH ELEVATED GRIT CHAMBER

is built up to make a cone hopper, 2 ft. 4 in. high at the periphery, with terra cotta partition tile faced with smooth-trowelled concrete. The settling period at first was 2 hr., but this time was varied. It is considered desirable to run at a high rate on starting to get sludge into the digestion chamber.

OPERATION

From the settling tank, part of the clear sewage will pass by an orifice box and a cam-controlled butterfly valve to the Taylor nozzle in the sprinkling filter. The head is varied from 2 to 7 ft. The filter is constructed inside a wooden-stave tank, 14 ft. in diameter and 10 ft. deep. A false bottom of 2 x 4-in. timbers laid flat and 2 in. apart is covered with stones from 2 to 4 in. in size. Above the underdrain is a 7½-ft. layer of 1¼ to 2-in. commercial crushed limestone from Greencastle, Ind., washed and screened to remove dust and fine particles. A wind shield of galvanized iron is built up 3 ft. high around the top of the filter. The effluent from the sprinkling filter passes to the secondary settling basin of 240-gal. capacity, built of galvanized iron and designed to provide a settling period of 1 hr. when the filter operates at 5000 gal. in 24 hr.

Provision for analyzing the samples has been made by fitting up a laboratory in the newly completed filtration plant.

Investigations of the sewerage conditions at Decatur as to the probable sizes required, interceptors needed, runoff and surveys, were carried out by Langdon, Pearse, Samuel A. Greeley and the Central Engineering Bureau, of Chicago. Dr. Arthur Lederer supervised the equipment of the laboratory and R. A. Allton is resident engineer in charge. P. T. Hick is city engineer.

A City Founded on Sawdust

How Part of Muscatine, Iowa, Came to Be Built on Such a Foundation—
Engineering Problems Encountered in Laying Pavements and Sewers

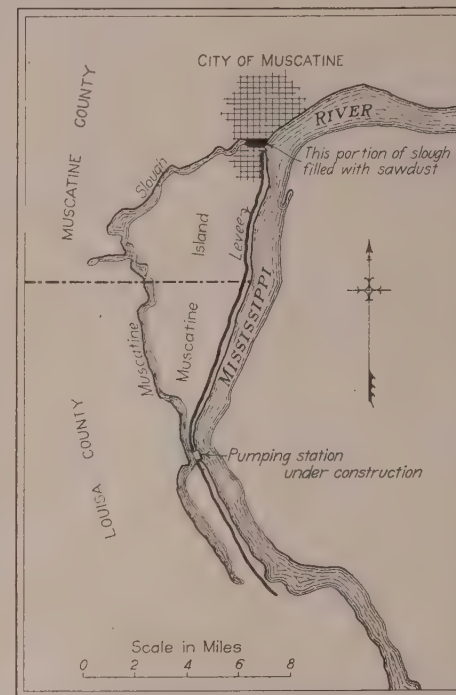
SAWDUST and other mill refuse to a depth of from 3 to 15 ft., with a slight veneer of earth as a covering, form the foundation of a part of the city of Muscatine, Iowa. Consequently the city has been confronted with unusual problems in the laying of pavements and sewers.

About the first industry to locate in what was then known as the village of Bloomington, the name being subsequently changed to Muscatine, was a large sawmill located at the mouth of the Muscatine Slough. For a while the refuse from this mill was used to fill up around the buildings, but more ground was needed for storing lumber. As a result the lumber company pushed its territory out over the lowlands bordering the Mississippi River, reclaiming land with mill refuse and protecting it along the river.

In 1841 a grant was obtained from the state of Iowa to build a dam across the mouth of Muscatine Slough at Green Street, thus connecting the river-swept Muscatine Island (downstream from the slough) with the city. The dam, which was about 20 ft. in width, was used as a roadway for teams passing over to the island, which is about 15 mi. long and 8 mi. wide. Then the lumber company started to fill in around the dam, using the refuse from the mill, to make more land for its lumber yard.

In 1858, as the result of a joint session of the board of supervisors of Muscatine and Louisa counties, it was decided to build a levee which would shut out the flood waters from Muscatine Island and the low-lying mainland. Realizing that cheap factory sites were to be had along the river on Mus-

catine Island, three lumber companies built factories along the main traveled road, and soon the South Muscatine and Musserville



LOCATION OF LEVEE AND SAWDUST FILL

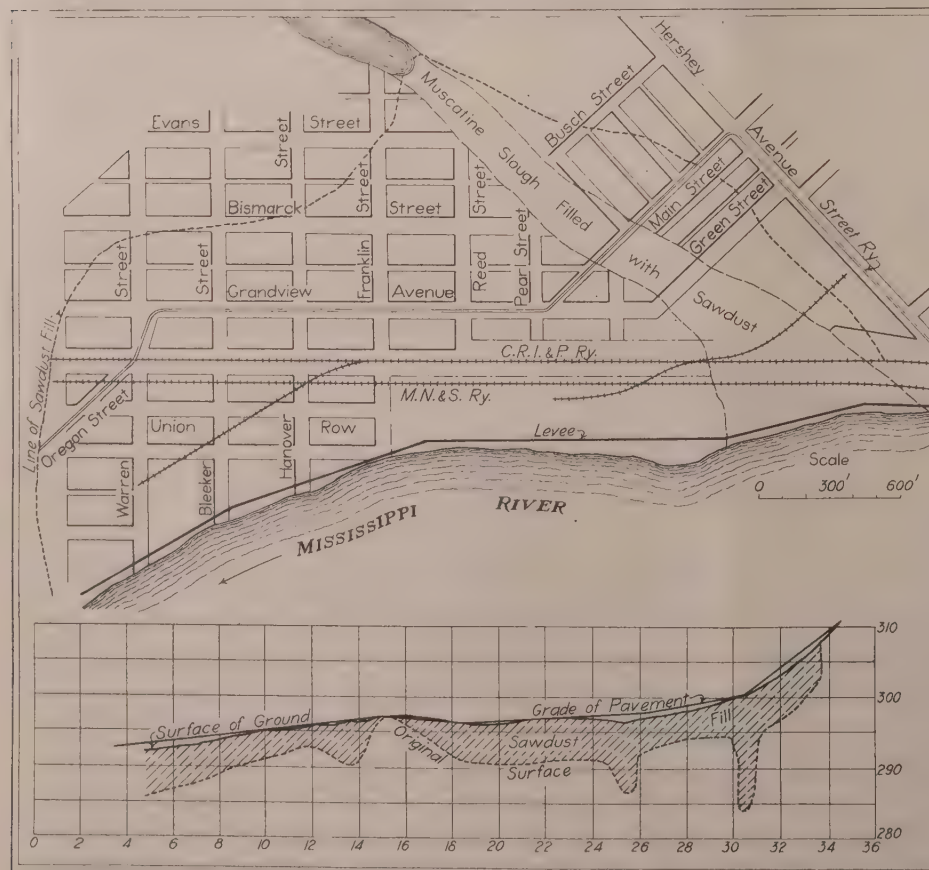
additions were laid out on the northerly part of the island. Each of the new mills started to reclaim adjoining territory with refuse from their factories. The Hershey Lumber Company erected a shaving blower and filled in Muscatine Slough for six blocks.

All of the yards around the properties have had a coating of earth applied to them from a near-by hill in order that vegetation might be raised. Many thousands of yards of earth for covering purposes have been hauled into this territory by wagon, but there is still quite a stretch which, as yet, reveals the bare sawdust.

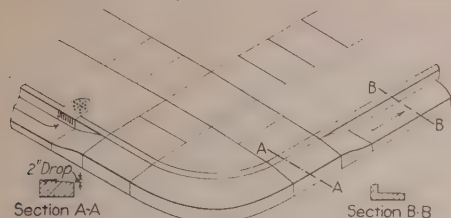
The territory behind the levee was never filled to a greater height than from 5 to 7 ft. below high-water mark, and it was found that although the river fluctuated from 18 to 20 ft., the fluctuation of Muscatine Slough after the levee was built was only about 3 ft. When the river was low, at a stage of from 3 to 5 ft., the water was let out from the slough at the lower end of the island through flood gates, and the gates were closed as soon as the water started to rise, thus keeping the water low behind the levee.

ENGINEERING PROBLEMS ARISE

As the result of considerable building on the island there recently came the problem which had been talked over for many years, of putting in some sort of pavement in the streets of this level and low-lying district, which was underlain with from 3 to 15 ft. of mill refuse and lay 5 ft. below high-water mark. The difficulty of laying sewers in this territory was another problem which seemed to demand attention. At last it was decided to construct a storm-water sewer into the Muscatine Slough, keeping the pipe from 3 to 4 ft. underground, and in 1912 a sanitary sewerage



AREA AND DEPTH OF SAWDUST FILL IN MUSCATINE SLOUGH
Profile is that of Grandview Avenue and Green Street



PERSPECTIVE OF TYPICAL STREET CORNER

system was planned with a pumping station near the river, allowing the sewage to discharge by gravity when the Mississippi was at an elevation of 5 ft. and to be pumped by a centrifugal pump when between the elevation of 5 ft. and that of 20 ft. This would cause pumpage from three to six months in the year with a 5-hp motor. Authorization for the construction of the sewer has not been made as yet.

In 1912 the matter of paving arose again. Upon investigation it was found that the lines of the Chicago, Rock Island & Pacific Railway near by had been built over similar ground and that the settlement in ten years was scarcely noticeable. E. W. Boynton, now with the General Construction Company, of Davenport, Iowa, states that about 1400 ft. of the Rock Island is built on 6 ft. of rattlings and sawdust. Two feet of earth was placed on the roadbed, and after thirty-one years hardly any settlement had been recorded. The Muscatine North & South Railroad has been built over similar sawdust and mill refuse beds with the same result.

LAYING CONCRETE ON SAWDUST

With the above information at hand it was decided to construct a vitrified block pavement with a 5-in. concrete base on Grandview Avenue and Green Street. The concrete under the street-railway track was made 11 in. thick, and the curbs on each side run down to meet the concrete base, thus forming abutments to receive the thrust of the two roadways laid across the street. The base was constructed with a concrete composed of a 1:3:6 mix where stone was used, and a 1:3:5 mix using local river gravel. Sand was used for cushion and filler material. The subgrade was rolled with a 3-ton roller, because it was difficult to use a heavy roller, care being taken to remove any large logs, rattlings or old planks to a depth of a foot below subgrade.

The finished street, which is one of the heaviest traffic arteries leading into the city of Muscatine, has been in use under the heavy traffic of lumber wagons and

A typical street corner is shown in perspective. The storm sewer and water pipes along the line of the pavement were placed in the parkings on each side of the street, so that the street would not have to be

opened at any time. There has been no maintenance cost on the pavement since its construction. The work was carried out under the supervision of C. H. Young, city engineer of Muscatine.

Literature

For the Civil Engineer and Contractor

New Publications

DIRECT-ACTING STEAM PUMPS. By Frank F. Nickel, associate in mechanical engineering, Columbia University. Cloth, 6¼ x 9¼ in.; 258 pages; illustrated. New York, McGraw-Hill Book Company, Inc. \$3 net.

THE YELLOWSTONE NATIONAL PARK—Historical and Descriptive. By Hiram Martin Chittenden, brigadier-general, U. S. Army (retired). Author of "American Fur Trade of the Far West," "History of Steamboat Navigation on the Missouri River," etc. Cloth, 5½ x 8 in.; 350 pages; illustrated. Cincinnati, Stewart & Kidd Company. \$1.75 net.

DUST PREVENTION. Bulletin 6 of the Illinois Highway Department. By Frank L. Roman, testing engineer. Paper, 6 x 9 in.; 40 pages; illustrated. A general outline of surface oiling as applied to macadam, gravel and dirt roads. The treatise is written in non-technical language for township, county and city officials. There are given specifications for the purchase of various grades of oil.

THE FLOW OF WATER IN IRRIGATION CHANNELS. Bulletin 194, U. S. Department of Agriculture. Paper, 6 x 9 in.; 68 pages; tables and diagrams. Washington, D. C., Government Printing Office. Results of extended tests to determine the retardation factor in Kutter's formula under the various conditions found in modern practice are detailed for the use of engineers who design irrigation, drainage and power channels.

Books Reviewed

Hancock's Applied Mechanics for Engineers

Revised and rewritten by N. C. Riggs, professor of theoretical and applied mechanics, School of Applied Science, Carnegie Institute of Technology. Cloth, 5½ x 7½ in.; 441 pages; 289 illustrations. New York, The Macmillan Company, \$2.40.

Reviewed by Melvin L. Enger

Assistant Professor of Theoretical and Applied Mechanics, University of Illinois, Urbana

According to the preface of this book, "the author has had in mind the fact that the student finds much difficulty in seeing the applications of theory to practical problems. For this reason each new principle developed is followed by a number of applications. In many cases these are illustrated and they all deal with matters that directly concern the engineer." Concern-

of the gyroscope, and incorrect statements concerning the motion of a particle on a twisted curve, have been corrected. Statements of principles have been rewritten in better form, many figures have been redrawn, about two hundred new problems have been added and the general appearance of the book has been improved. The work of revision has been well done.

Not enough time can be taken in most schools to cover the entire book. Much of the matter, however, can be omitted without destroying the continuity. The treatment of moment of inertia seems needlessly long, the chapter on friction contains much matter which can be taken more profitably in specialized courses, the treatment of the pendulum is more complete than is justified by its engineering applications, and the derivation of the flexure formula (added in revision) seems out of place.

The typography is excellent. The use of small type for problems and of bold-face type for important formulas, and the arrangement of the mathematical work, make it easy to pick out the important parts. By the use of a better grade of paper the volume is considerably thinner than the old edition, although about fifty pages have been added.

Handbook of Construction Plant

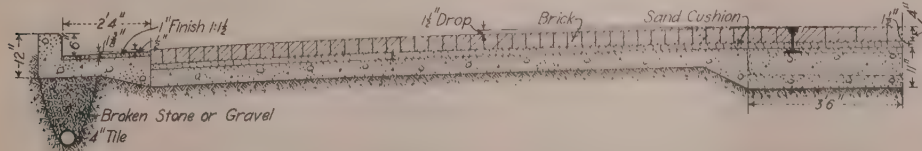
Author, Richard T. Dana. Leather, 5 x 7 in., 702 pages, illustrated. Chicago, Myron C. Clark Publishing Company. \$6 net.

This book was compiled as a guide to the proper selection of plant and tools for different classes of construction work. Being practically the first attempt in this line, it naturally suffers from some incompleteness. The idea behind it, however, should prove even more valuable in future editions than in the present. A great many kinds of machinery are described, together with the conditions and work to which each is suited. Much valuable data are given as to the cost of operation of certain types of machinery. These data should prove the most useful part of the work, as they furnish practically the first published basis for selecting machinery by considering its saving in costs as compared with depreciation and interest on its purchase price.

An Introduction to Town Planning

Author, Julian Julian, borough surveyor, Cambridge, England. Cloth, 5½ x 8 in., 149 pages, 9 illustrations. London, Charles Griffin & Co. 5s. net.

This work will be of value to American readers chiefly as a reference, to find out under what laws town planning is now carried forward in England. Three chapters are devoted to this phase of the subject, under the headings, Authorities and By-laws, Powers of Local Authorities, and Practical Considerations in the Preparation of Town Plans. Besides summaries of the legal powers, there is much information



HALF-SECTION OF BRICK PAVEMENT ON CONCRETE BASE IN SAWDUST AREA

farm produce since September, 1912, and there is no apparent settlement or failure. The mill refuse was in a good state of preservation when the pavement was laid, inasmuch as ground water was constantly near the surface, and there was no successive drying and wetting. The city engineer believes, therefore, that there will be no decay during the life of the pavement, and that where settlement does occur it will be more or less equal.

ing the revision it is stated that "although rather extensive changes in method of treatment have been made in certain parts, the general subject matter and order of arrangement have been, in the main, retained. . . . An important change is to be found in the much larger use of graphical methods."

A comparison of the old and the revised edition shows that many improvements have been made. Errors in the treatment

on such subjects as street widths and character on parks, on details of buildings, and on housing and sanitation rules. Opening chapters review briefly the history of ancient, mediaeval and modern town planning, while the closing pages present in a few words for each the chief characteristics of town planning in a number of European cities.

Working Data for Irrigation Engineers

Author, E. A. Moritz, engineer, U. S. Reclamation Service. Cloth, 6 x 9 in.; 395 pages; 42 illustrations. New York, John Wiley & Sons, Inc. \$4 net.

Reviewed by B. A. Etcheverry

Head of Department of Irrigation, University of California, Berkeley

The main purpose of this book, as the title implies, is the presentation of working data, for irrigation engineers, to facilitate the hydraulic and structural design of irrigation canals, flumes, pipes and structures.

The book may be divided into five main parts. The first part, containing 75 pages, gives a brief and fragmentary consideration of some of the features pertaining to the examination, reconnaissance and investigations of irrigation projects and of some of the principles of the design of irrigation structures. The discussion is based largely on the U. S. Reclamation Service practice, and is too brief and indefinite to be of any great value. The purpose of this part of the book is not apparent.

The second part, containing 128 pages, or about one-third of the book, presents hydraulic diagrams and tables, and is the most valuable part of the book. There are 10 diagrams for the solution of problems by Kutter's formula, which give the relation between V , R and S for values of N ranging from 0.010 to 0.035. Tables for the corresponding values of C in Chezy's formula $v = C \sqrt{RS}$ are also given. There are 20 diagrams which give the hydraulic elements of different forms of canal cross-sections; in detail these give the relations: First, between A (area), b (bottom width), d (depth) and r (hydraulic radius); second, between A , V and Q . This is followed by diagrams and tables for the flow of water in wooden-stave, cast-iron, concrete and steel pipes, and for the discharge over weirs. A list of hydraulic formulas concludes the section. The majority of the diagrams are based on the valuable tables of the Reclamation Service, published in their handbook "Hydraulic and Excavation Tables." In the preparation of the diagrams, logarithmic scales have been generally used and represent a great deal of work on the part of the author. The diagrams are well arranged for use, and the scales selected are consistent with the degree of accuracy required.

The third section, containing 54 pages, includes canal excavation tables, reproduced from the above named publication of the Reclamation Service, and a large number of tables and diagrams of useful data for the designing engineer.

The fourth part, of 58 pages, includes miscellaneous tables and data, such as stadia tables, logarithms, trigonometric functions, squares, cubes, etc. These data are available in other sources, but their inclusion is a convenience.

The fifth section, of 74 pages, contains general specifications. The author states that the "main intention is to state the important points to be covered rather than to

state how they should be covered." They should be useful for this purpose, as they cover both general construction and materials. They are based on the standard specifications of the Reclamation Service, with some of the clauses which apply only to Government regulations omitted.

This work should be of value to irrigation engineers, particularly in office computations and designs. The extensive use of logarithmic plotting is to be commended.

Engineering Office Systems and Methods

Author, John P. Davies. Cloth, 6 x 9 in.; 544 pages; 243 illustrations. New York, McGraw-Hill Company, Inc. \$5 net.

Reviewed by R. Fleming

American Bridge Company, New York City

This important book is written by the engineer of the Honolulu Iron Works, a firm of consulting and contracting engineers in New York City. He has drawn upon the information furnished by a wide range of books, technical journals and manufacturers' catalogs, supplementing it from his own varied experience.

Chapter 1 is given to the collection of preliminary data for engineering projects, including foundation testing, stream gaging and information to be obtained before making designs and estimates. The second portion of the chapter might be criticised for needless detail. Although the designer cannot have too much preliminary information, there are many points that can be settled better by him than by the purchaser, who is seldom an engineer.

The second chapter is entitled "Designing and Drafting Systems." The outlines for engineering designs for different types of structures are excellent. A page is found on the investigation of the strength of old steel bridges. The portion on the checking of engineering drawings is to be commended, especially the directions for checking the anchor-bolt plan and three "reminders" in the examination of structural steel details: Check for reduction of template work, check for reduction of expensive shop work and check for reduction of erection expense.

Chapter 3 is on specifications of engineering material, with many outlines of specifications.

Chapter 4, of 75 pages, is entitled, "Reminders for Obtaining Quotations on Standard Material." Machines and material of many kinds are treated in detail, the author's theory being that by submitting information as full and complete as possible in the first place much closer prices can be obtained.

Three chapters follow on purchasing-office methods and forms, cost keeping and estimating, and sampling, inspecting and testing engineering material. The detail notes and reminders regarding structural-steel estimating are thorough. The reviewer would think such a caution as, "Be careful not to omit whole floors," unnecessary, did he not know of a case where an engineer estimated the "typical floor" as one floor.

Chapter 8 is devoted to domestic shipping and chapter 9, of 60 pages, to the intricacies of export shipping. To some engineers chapter 9 will be the most interesting in the book.

Succeeding chapters are on progress charts, scheduling systems, etc., indexing and filing systems, etc., for the engineering office; and drawing-office systems and

methods. What the author writes of certain charts is true of the chapters throughout—their whole value lies in their suggestive probabilities. What is used by one company must be modified according to results desired, the personal equation, and a number of other conditions before it can be adopted by another. To the three pages on technical letter writing might be added a few on technical and other English. Many engineers are deficient in the correct use of English. The author, by the way, uses the word "strain" where "stress" is meant.

Chapter 13, the last and shortest in the book, is entitled "Miscellany."

From the foregoing the broad scope of the book is apparent. The experienced engineer will find much of interest, but it will be of special value to the engineer who is getting his experience. It will be a boon also to any who desire more knowledge in lines akin to those in which they are engaged. For instance, the designer and estimator can obtain considerable information regarding the work of the inspector or purchasing agent.

The author writes in an attractive style, brings his references to recent dates and is generous in giving credit to the writings of others. He also has that rare quality of knowing his limitations, as is seen in the chapter on export shipping, where he writes, "Care has been taken to make statements and figures as nearly correct as possible, and to qualify remarks properly in the case of exceptions to general rules; the professional shipper, however, will probably notice many omissions and half-truths."

The typography of the book, the table of contents in the beginning and the index at the end are all that need be desired. In conclusion, the book deserves a place in every technical library.

Plain and Reinforced-Concrete Arches

Author, J. Melan, professor of bridge design at the German Technical School at Prague. Authorized translation by D. B. Steinman, Ph. D., professor of civil engineering at the University of Idaho. Cloth, 6 x 9 in.; 161 pages; 44 illustrations. New York, John Wiley & Sons, Inc. \$2.

Reviewed by F. H. Constant

Professor of Civil Engineering, Princeton University

This book is a translation of Prof. J. Melan's article on arches, "Theorie des Gewölbes und des Eisenbetongewölbes im Besonderen," published in the second revised edition of F. von Emperger's Handbuch für Eisenbetonbau (Berlin, 1912). This is the second volume of Professor Melan's work to be placed in English and published in this country by Professor Steinman (see review of "Theory of Arches and Suspension Bridges," Engineering Record, Sept. 12, 1914).

The present work of 161 pages covers only plain and reinforced-concrete arches. Chapter 1 deals with the general forces and line of resistance in an arch. Chapter 2 develops the equations for maximum fiber stresses at any section of a rib in terms of bending moment M and thrust N . The two phases, Phase 1 for slight eccentricities of N , occasioning only compression in the section or insignificant tension, and Phase 2 for larger eccentricities yielding tensile stresses exceeding the resistance of the concrete, are considered.

Chapter 3 on the three-hinged arch is handled mainly by the graphic process with the special analytic treatment of the para-

bollic arch for full and half-live loading. For the severe case of live loading covering alternately the left and right halves of the arch, the mean or best arch curve is found approximately to coincide with the line of resistance for the dead load and half the live load considered as distributed over the entire span. The well-known treatment by influence lines is included.

The next three chapters on the hingeless arch for vertical and non-vertical loads and the effects of temperature, and the displacement of the abutments are the fundamental ones of the book. The analytic method does not differ essentially from that given in recent leading American works on the subject. The arch is considered cut at the crown and the unknowns are M_o , S_o , and H_o at this point. The deformation equations of condition, however, are obtained by the principle of work (Castigliano's Theorem), by which, for the case of the hingeless arch, $dW/dH_o = 0$, $dW/dS_o = 0$, and $dW/dM_o = 0$ (see Church's Internal Work), where W is the work for the two halves and includes the action of both the moment M and the thrust N (rib shortening). The resulting equations for H_o , M_o , and S_o can be put in comparatively simple form for solution by the tabular method. The reviewer does not at all agree with the author's reiterative statement that the precise calculation of maximum stresses by the influence values for unit load concentrations is too laborious to carry out, and that but two conditions of live loading (half span and full span) should be considered.

The German predilection for graphic processes and their ingenious development of this art are well shown in the graphic solution which here receives prominent treatment. After the direct simplicity of the analytic solution the graphic method seems rather roundabout and artificial. The author's statement that maximum fiber stresses follow from the positions of loading giving maximum positive or negative moments, is not strictly true for reinforced concrete, since the value for the thrust N is an important factor.

Chapter 5 discusses the effects of temperature. The Swiss and the new Austrian specifications prescribe a range of ± 27 deg. Fahr. Chapter 6 gives the analytic and graphic solutions for non-vertical loads. Chapter 7 attempts to obtain an approximate solution of an arch by certain simplifications which seem to the reviewer to be too general and too loose to be of much practical value. Chapter 8 discusses briefly the cases of two-hinged and one-hinged arches. The treatment of elastic abutments and arches, continuous over several spans (Chapters 9 and 10), is new in American literature. It is a little too condensed here to be perfectly clear, and the importance of the subject would justify considerable expansion of these chapters in a later edition. Chapters 11 and 12 for determining the best curve for any arch and the thickness of the rib are highly theoretical, and to the reviewer at least, who would welcome an out and out empirical rule based upon a wide and practical experience, are not at all convincing. Chapter 14 takes up again the calculation of fiber stresses in the arch, but more especially for the case where the axial thrust is small. After deducting its effect from the allowable compression for concrete, the bending moment alone is considered. The author has constructed an interesting graphic chart (Plate 1) for giving at once the percentages of reinforcement

at top and bottom in a section subjected to a reversal of moments.

The book closes with an appendix containing complete computations of stresses, analytic and graphic respectively, of two bridges of the Melan type of reinforcement, one at Genoa and the other at Lausanne.

While the translator states that the original text has been faithfully followed throughout, he has succeeded admirably in producing a free and completely Americanized translation. The notation has been modified and the units converted from metric into English units. The book is an important addition to the literature of the reinforced concrete arch, and much credit is due the translator for bringing it within the convenient reach of American readers.

Preventing Losses in Factory Power Plants

Author, David Moffat Myers. Cloth, 5 x 7½ in.; 560 pages; 68 illustrations. New York, The Engineering Magazine Company, \$3.

Not a book for the designing engineer, but for owners and managers of factory power plants, and at a time when there is so much discussion in regard to private plants and central-station power, the book is of special interest to them. The first nine chapters cover the ground in a general way and of these chapter 9, "The Human Factor," deals with the most important element of power-plant operation.

Numerous illustrations are given from the author's experience of plants investigated where large gains have been made after careful study of the problems involved. It is such a book as owners and managers should read to bring them to realize that the power plant and the men operating it are worthy of their attention, and that the efficiency of a majority of power plants can be increased by such interest, often at a comparatively small expense.

Who Built the Panama Canal?

Author, W. Leon Pepperman, chief of office of administration, Second Isthmian Commission. Cloth, 6 x 8½ in., 420 pages, 31 illustrations. New York, E. P. Dutton & Company, \$2.

The answer given to his title question by the author is Theodore P. Shonts—to whose staff, by the way, the author is attached. While Mr. Pepperman himself would object to this single-word summary of his book, protesting that his aim has been rather to show that the second Isthmian Commission, which he calls the "Railroadmen's Commission," was chiefly responsible for the sanitation, organization and design, the impression made by the book is decidedly that of the glorification of an individual.

Mr. Pepperman reviews briefly the inception of the Panama work, scoring roundly the first commission, without, however, showing the limitations imposed on the commission which seriously handicapped its work. He then proceeds to detail the conditions under which Mr. Shonts was made chairman of the second commission and the progress of the work of sanitation, organization and design. To his mind the important work was completed when the second commission went out of existence, and nothing but routine was left and a routine to be carried on by a self-running machine perfectly adapted in every respect for the task in hand. His attitude is plainly shown by his quoting with approval the following remark of a railroad engineer em-

ployed by the second commission: "We built the machine and started it going, and then gave the handle to Goethals, who turned the crank and ground out the results." Further in the volume are found such disparaging phrases and sentences as the "mere digging of the canal"; "Once given conditions approximating modern civilization in the Canal Zone . . . all that remained of the canal construction problem was 'to make the dirt fly'"; "But he (Mr. Shonts) did not surrender control at Panama until convinced that the completion of the work was merely a matter of routine that might be accomplished by any highly competent executive."

The second commission undoubtedly did do a great work at Panama, and it was right that some one should present the accomplishment clearly for the enlightenment of the American people. One could wish, however, that it might have been done by some one, equally well informed, but less partisan, and not intent upon belittling the efforts of those who went before or the work which faced those who followed the "railroad regime." Mr. Pepperman's book to a measure is prejudicial to his own cause, for even the layman need not be told that Goethals and his confreres have done what is outstanding in its magnitude and in the skill with which it has been conducted. No amount of disparagement will reduce the credit which the present chief and his staff deserve and are accorded. They have fully acknowledged their indebtedness to their predecessors, not once but many times. They concede that under Shonts Gorgas cleaned up the Isthmus, that under Shonts the canal forces were effectively organized, the labor recruiting system was hit upon and developed, the Panama Railroad rebuilt, the excavating plant largely assembled, a magnificent esprit de corps developed and a modern standard established for the cities at either end and the construction towns.

There are supplementary chapters on the trials to which canal officials were subjected by attempts to start scandal and by misrepresenting conditions on the Isthmus and on Bunau-Varilla's connection with the Declaration of the Republic of Panama. One chapter describes the canal briefly and points to its economic significance.

A valuable feature of the volume is the reproduction of Joseph Pennell's remarkable sketches of the work on the canal.

A SHADE TREE CENSUS is to be taken at Binghamton, N. Y. Arrangements have just been completed between the authorities who have in charge the public parks and public schools of that city and the New York State College of Forestry at Syracuse University for the taking of such a census. The work is outlined and the necessary material and instructions are furnished by the State College of Forestry in such a way as to make the field work of distinct educational value to the pupils in the public high schools. The information gathered will be used in the preparation of a shade-tree map for Binghamton. It is the plan of the State College of Forestry to extend this census-taking of street trees by high-school pupils throughout the State as rapidly as possible and it is hoped that this work by the pupils will, in many cities of the State, be the beginning of the proper planting and preservation of public shade trees.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Could Use Diesel Engine to Run Air Compressor

SIR: I have read with much interest the article by Mr. Hammond about the Diesel engine in the Engineering Record for March 27. The same idea has been in mind with me as long ago as 1910, when I was in charge of sinking a mine shaft in Minnesota as a pneumatic caisson. On another of these shafts in Michigan, where coal had to be hauled $4\frac{1}{2}$ miles from a railroad and cost \$5.50 a ton at the job, it took 20 to 25 tons a day to make air enough for a 29-ft. diameter caisson. The scheme always appealed to me as a likely one for caisson jobs, where coal is high. Larger pneumatic contracts would stand figuring on, to say the least, perhaps with the Diesel engine used directly to drive compressors, furnishing air for most of the construction plants as well as for the caissons. This sort of an arrangement will appeal to many men whose average job is smaller than the one taken for your illustration, as, if their equipment is not electric, their investment would be confined to the power house, and they would be able to use their present equipment of hoists, etc., as it stands.

R. JACKSON.

East St. Louis, Ill.

Doubts Reliability of Diesel Engine

SIR: The writer has read with much interest Mr. Hammond's article on "The Diesel Engine for the Contractor—Why Not?" in the Engineering Record of March 27. About a year ago, while investigating the adaptability of the Diesel engine as a marine engine on small vessels, the same tempting economies were arrived at. But the writer wishes to mention a few of the practical difficulties of which he became aware in the course of talks with some who had used the Diesel engine.

To make clear succeeding statements the working of a Diesel engine will be very briefly outlined. After an impulse stroke and after the cylinder has been scavenged all valves are closed and the piston in its upward stroke compresses the air in the cylinder to 500 or 600 lb. per square inch. This creates a temperature of 1000 to 1100 deg. Fahr. Just before the dead center the fuel oil is injected under an air pressure of about 800 lb. per square inch. The oil ignites and gases of combustion impart an impulse to the piston. The compressor for generating the 800 lb. pressure for fuel injection is 2- or 3-staged and runs directly from the crank shaft. The air is generally water-cooled between stages.

It hardly seems likely that repairs to machinery subjected to such pressures and temperatures should cost no more than those to other machinery working under, say, a pressure of 120 lb. and a temperature of less than 400 deg. Fahr. Indeed, the practical difficulties are just what these conditions would lead one to expect. Valves are apt to warp and leak. Cylinder's heads are apt to crack. The cylinders are apt to crack around exhaust ports, if there are

any. Pistons sometimes become overheated and seize. The high temperatures in the air compressor have been known to ignite the lubricating oil, cracking the air pipes by the excessive pressure thus caused.

Manufacturers, both American and foreign, are devoting their best energies to overcome these difficulties, and will ultimately succeed. It is doubtful, however, if any contractor would now run the risk of depending solely upon two 500-hp Diesel engines for power on a \$6,000,000 contract. Diesel engines are hardly reliable enough. It is not to be expected that the same degree of reliability that has been attained in the steam engine after a century of development should be attained in the course of some twenty years in the Diesel engine with its high pressures and temperatures.

Probably the ideal way to test Mr. Hammond's idea would be on a job where cheap electric current can be purchased close by. The contractor could then go to some builder of Diesel engines, get his guarantees, and go ahead. Then if troubles developed the work would not stop.

EBERHARDT MUELLER.

Camp Hill, Pa.

[Probably the best answer to this letter is to invite contractors to investigate industrial installations and municipal electric light plants operated with this source of power. Figures as to repair bills in installations of this kind are available and have been seen by the author of the article referred to. They indicate that while what Mr. Mueller says was doubtless true of the early installations of the Diesel engine in this country, these engines have now reached a state of reliability which compares well with that of the steam engine.—EDITOR.]

Filters Balk at Operating Methods of City Fathers

SIR: A striking case illustrative of the waste and extravagance in our municipal governments has recently come to the writer's attention. As is common in most or at least a great many of such cases, the waste was due to a commendable desire to save money, together with ignorance as to the means of doing so.

A Western city of some five or six thousand inhabitants several years ago constructed a gravity water system costing approximately \$325,000. The system included about 35,000 ft. of wood-stave pipe carrying the water from the river to reservoirs and slow sand filters located on a hill above the city. The line is of 30-in. pipe and is supposed to carry about 22 sec.-ft.

The purification works consist of a settling basin, two slow-sand filter beds and two clear-water reservoirs. The filters cover approximately 1 acre each. The filter material consists of 12 in. of coarse gravel, 12 in. of coarse sand and 24 in. of fine sand.

After the construction of the filters they were placed, in accordance with the custom in small cities, in the charge of men who apparently knew nothing of their care and operation. The men, no doubt, never heard

of such things as rate of filtration, loss of head, etc., but could be had for a small monthly wage. (The writer has been informed, unofficially, that the "water superintendent" gets \$70 per month.) No means had been provided for cleaning or regulation of any sort. Last summer, as a consequence of the belief that filters consist only of sand through which the water seeps and that they do not require expert knowledge to maintain efficiently, the beds reached such a condition that they would no longer fulfil their mission.

Never having heard, possibly, of the removal and washing of sand, the committee of the council having charge of the system (an eye, ear, nose and throat specialist being chairman) had the filters cleaned of the old sand, which was replaced by new, clean material. So far as is known no engineering advice was obtained or even sought. Suffice it to say that a very large quantity of sand was hauled a distance of several miles. Just how much was hauled, or at what cost, could not be ascertained by the writer. Upon the occasion of the writer's last visit to the filters, however, one basin had been entirely cleaned of sand and was about half filled with new material. The amount of sand required for one basin is very nearly 5000 cu. yd. To those who know the cost of filter sand it will readily be seen that the salary of a fully competent man could have been paid for several years. And in addition the city would have been saved the necessity of consuming raw river water during the period the filters were out of commission.

To cap the climax some one advanced the rather novel idea of securing sand for the beds by placing sand in the intake of the pipe line, on the theory that it would be carried through the 35,000 ft. of pipe to the settling basin adjoining the filter beds—this in spite of the fact that the line contained several inverted siphons of 100 ft. head and over. Sand carried by gravity in opposition to a 100-ft. head, is, quite naturally, a simple matter. The water committee of the council adopted the idea, this time contrary to gratuitous engineering advice, and it is understood that some 350 cu. yd. of sand were actually dumped into the intake chamber. Some reports placed the amount as high as 500 cu. yd. Needless to say it stayed in the pipe line—just where it is perhaps no one knows—but it is a safe conjecture that the first long inverted siphon contains its full quota.

It was reported around the city that the originator of the idea was to be paid at the rate of \$6 per day if the scheme worked, and \$3 per day if it didn't work.

The outcome of the matter was that early in the present year the city resumed the use of its old pumping plant and the taxpayers used raw river water again. The pipe line was frozen in several places. The presumption was that the pipe was so filled with sand that the slush ice which ordinarily passed through without trouble became lodged and froze solid.

In any event the experiments have proved costly to the taxpayers. Just how costly could not be ascertained, as the experimentation is not yet at an end and the council members responsible for the waste are very reticent in the matter. Just when the American public will awaken and elect men to office because of their qualifications instead of their popularity seems uncertain. In this particular case the time would seem to be ripe.

ENGINEER.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[Contributions to this section are solicited, and if found available will be paid for. They must be SHORT, and should be accompanied, if possible, by photographs or sketches.—EDITOR.]

Pointers on Trestle Building with Easily Moved Pile Driver

By GEORGE A. EATON
New York City

AN overhang pile driver which is easily moved in any direction without blocking or rollers is shown in the accompanying cut at work on a temporary double-



PILE DRIVER WITHOUT ROLLERS

track trestle on the New Haven road at Pelham Bay, N. Y. After traffic was diverted over this structure, the old trestle in the foreground was replaced with a six-track trestle 102 ft. wide on 36-pile bents placed on about 10-ft. centers.

The machine shown was 42 ft. long, and its skids, which were shod with dressed maple plank and kept well greased, slid directly on the caps. Moving forward or backward was done with one set of falls, one end run ahead or back as required. Two U-bolts in a cross-brace of the bed-frame directly in front of the engine are used to hook the other end of these falls in. The rig was pulled sidewise by a set of falls attached to a U-bolt on either side of the bed frame.

As few engineers in sticking a pile can hoist the hammer and the pile at the same time, even if there be steam enough to raise both, there is no object in having the pile line on the front drum. A runner line from one winch-head was used to handle piles on this rig, with the result that when the hammer reached the top of the leads the pile was also raised and ready to stick, and no time was lost. The lead from the falls for moving ahead or back was permanently fastened on the front drum instead of the pile line, which also

gave greater speed in moving. The lead from the falls for moving sidewise was run through a snatch block to one winch-head.

Although this machine was operated with a drop hammer, it drove a bent a day for some time. To keep the hammer hitting piles an extra gang was put on sawing off and capping (each cap was in several sections) as the driver moved sidewise. In order not to stop the driver to raise the caps, a toy stiff-leg derrick, with 12-ft. sills, a 10-ft. mast and a 14-ft. boom, of 6 x 6-in. timber provided with manila rope falls, was used to hoist the caps. This derrick was so light that it could be dragged around on plank skids with a runner line from the driver. To hoist a cap, the sills were tied down with rope slings. A line to a winch-head of the driver was also used to raise the cap timbers.

This trestle was built about ten years ago, but the type of driver and the other time-savers used on the job are by no means out of date, and have repeatedly been used with success by the writer.

Truck Used as Deadman

By W. G. FLETCHER
Newark, N. J.

ARIGGER in Newark, N. J., recently backed a heavy truck against the curb at the new terminal station of the Newark Public Service Corporation and used it to anchor a guy derrick in clearing up the wreckage of a locomotive crane. The crane had turned over on the side of a bank and it was found necessary to set up a temporary derrick in order to right it. On the side where the truck was used no other anchorage was available, and the truck proved too light to allow lifting the body of the crane. Finally the wheels and trucks were removed from the crane and placed on the derrick. This lightened the load and weighted the anchorage sufficiently to permit raising the crane.



DERRICK WHICH CLEARED THIS WRECK WAS GUYED TO A DRAY

Greater Care in Employing Workmen Will Pay the Contractor

By H. D. HAMMOND
Associate Editor, Engineering Record

MAKING some effort to determine whether each man hired on a construction job will fill the bill is a thing that is both very desirable and seldom done. A contractor may well ask himself the question, "Do I get the most efficient force that could be picked from the men who apply at my jobs, and if not, how can I get it?"

Many superintendents and general foremen are capable of picking the right men for their work, and many make it their business to employ personally every man that is taken on. If the superintendent is a good judge of men this is the best way to take care of the matter. The trouble is that often the man in charge is either a poor judge, and knows it, or is too busy to attend to employing the men. Consequently, he leaves it to the foremen, who often are not able to tell a good man from a bad one till they see him work. As a result, foremen come to expect nothing from any man they put on, and form the habit of discharging men for the most trifling mistakes. A foreman who gets into this rut is never able to build up a good crew, or get the best out of the good men he does pick up. And when a foreman is not honestly trying to pick the best men he can, regardless of other considerations, various abuses creep in, and the efficiency of his gang often drops very low.

A campaign to educate foremen in this matter of selecting men, especially with a large company, would be nearly hopeless. For one thing, foremen with a large concern are often changing. Many men make first-class foremen who do not have it in them to be good judges of strange men. The general foreman, or superintendent, however, is rightly supposed to be of a superior class, and it can reasonably be demanded of him that he should know how to employ men.

The solution, then, is for a contractor to select his executive force so that he can put on each job at least one general man who is competent to do the hiring. Next, he must see to it that this man has time to attend to the matter. If the man be the superintendent, and his time is taken up with office detail, an assistant, or engineer, can relieve him so that he will be able to devote the needed time to employing his men. Such an assistant will more than save his pay in increased efficiency of the working force. It is a great mistake, in general, to take up a superintendent's time with signing checks, making reports and doing instrument work, if he is also the man relied on to plan and execute the construction.

If the general foreman is selected to employ the men, and his job keeps him too busy to attend to it, there is usually a quick solution of the difficulty. The things that take the general foreman's attention from arranging the work for his crews and helping to plan the progress of the job may be divided into two classes—breakdowns of equipment and blunders by the men under him. Contractors should spare no pains to minimize both these things, aside from the mere question of employing men. The extra money that represents the difference between equipment that is ready to run 24 hours a day and equipment that runs part time, and between competent and incompetent foremen, is literally only saved when it is spent. When it is spent it is usually much more than saved. If your general foreman does not have time to hire his men when the job is running smoothly, that is evidence enough that he is doing more work

having provided a definite man to employ others on each job, a contractor should watch that feature of the work carefully, and see whether each particular man's judgment can be improved. On visiting a contract it is often easier to tell what is wrong than to right it. If the wrong men are employed on one of your jobs, or men picked for one class of work are doing other work for which they are not fit, a little observation will disclose the fact. To set it right, however, may require both tact and patience. Nevertheless it will not be hard to find men enough in the average executive force who can at least be taught to do this work, if they are not able to do it already.

To interest these men and train them to this way of doing is at the present time the best of business. The man who waits till competition forces him to adopt a progressive measure stays right where he was before his competitors began to adopt it—a little to the rear of the procession and profits.

Rail Support for Ditching Under Railway Line

By M. P. MELLON

Place & Mellon, Contractors, Ensley, Ala.

A RAIL support which will carry Cooper's E-50 loading across a 9-ft. ditch is illustrated herewith. This device has been used by the writer with success in ditching under railway tracks in Alabama. The rails are 15 ft. long and of 80-lb. section. The saddle blocks are made of 1 x 6-in. steel, and the keys of 1 3/4 x 4 x 24-in.



RAIL SUPPORT BRIDGES 9-FOOT GAP



UNDER SIDE OF RAIL SUPPORT

than one man should. Either the superintendent should be free to help him, or he should have a competent assistant.

The selection of those foremen and mechanics who are not readily picked up at the work, and who are carried by a contractor from place to place, should be made, or at least passed on, by some one person in the main office who is an expert at the business of knowing a man when he has talked to him. No man should be taken on without a personal interview. A fair-sized contracting business can well afford at least one expert of this sort, whose main concern is employing men. Many readers will be able to recall instances where, for lack of such an expert, contractors have suffered from the most ridiculous mistakes made by men sent as competents by the main office.

steel. On a 7-ft. span the device is good for E-60 loading. It was made for the writer in a local frog and crossing shop.

Cement Gun Used on Imhoff Baffles at Fitchburg

EXPERIENCES in the use of the cement gun for forming the baffles in the Imhoff tanks of the sewage treatment plant at Fitchburg, Mass., were recounted by David A. Hartwell, chief engineer of the Sewage Disposal Commission of that city, in a paper presented March 3 before the Sanitary section of the Boston Society of Civil Engineers.

Thin partition walls of rib metal reinforcing lath with cement plaster were con-

structed in the Imhoff tanks to separate the sedimentation and digestion chambers and also completely around the sprinkling filter to prevent sand and gravel from working into the spaces between the broken stone. The metal lath used was the Rib-Trus manufactured by the Berger Manufacturing Company, of Canton, Ohio. The method of placing the plaster was optional with the contractor, either hand work or use of the cement gun being allowed in the specifications. The contractor decided to use the cement gun and the result, according to Mr. Hartwell, was fairly satisfactory.

The plans called for a thickness of 2 in. on both the partition walls in the tanks and the curtain wall around the filter. The type of lath used has such a heavy body of metal and such a small percentage of area of perforation that there is not, in Mr. Hartwell's opinion, as large a bond between the cement plaster on the two sides of the metal as is desirable. The limited area of this bond is such that the plaster breaks away when a not very heavy blow comes upon the wall. Again, in the Imhoff tanks when an attempt was made to smooth the surface of the plaster by troweling, it was easily loosened from the lath. Some form of metal lath with larger openings would be preferable but would probably require to be backed with forms to prevent the plaster from shooting through the lath.

Quality of Chuted Concrete Improved by Receiving Box

IN ORDER to secure homogeneous masses of concrete by the chuting method Fraser, Brace & Company, contractors, of New York City, who built the Deerfield River hydroelectric plant in western Massachusetts and also the Cedars Rapids water-power plant on the St. Lawrence River, customarily discharged their concrete into a bottomless box. In this way the larger aggregate which may have separated from the mortar is held until the latter comes down the chute after it. When the box is filled it is lifted and the concrete spread and tramped into position.

The scheme was also used on the Pennsylvania Station work in New York City under George G. Clarke, then resident engineer for the Pennsylvania Railroad, and now a member of the contracting firm above mentioned.

Concrete Placing Record Made at Balboa Pier, Panama

IN the construction of the north entrance pier at Balboa, Panama, which is connected with the north wall of drydock 1, a gang of men operating a 1/2-yd. Austin cube mixer, equipped with an elevator and movable chutes, mixed and placed 540 batches of concrete on March 9. In place, the 540 batches measured 275.5 cu. yd. and, according to the "Canal Record," this volume of material was placed in 7 hours and 15 min. actual working time. During the 8 hours' work there were the following delays: Broken chutes, 10 min.; repairs to mixer, 20 min.; moving mixer ahead, 15 min.; total delay, 45 min.

The labor cost, including supervision, was \$39.91, which makes a unit labor cost for mixing and placing of 14.48 cents per cubic yard. All the material was wheeled in wheel-barrows from a point about 100 ft. from the mixer. The average run per hour, actual working time, was 36.33 cu. yd.

Repair of Concrete Buildings at Edison Plant Sets Precedents in Construction Work

Original Estimate of Salvage of Concrete, Eighty-seven and a Half Per Cent, Borne Out by Data Gathered During Reconstruction

FOLLOWING the fire which swept the plant of Thomas A. Edison, Inc., at West Orange, N. J., on the night of Dec. 9, there were various conjectures as to the extent to which the damaged concrete frames could be saved and repaired. The engineers retained by Mr. Edison estimated that the damage to the structural work would not exceed 12½ per cent. Most of those who inspected the buildings did not make an estimate of the percentage of damage, but the opinion was general that the two upper stories of the west wing of Building 25 would have to be removed, and that the most heroic measures would be needed if Building 11 were to be saved. The columns in the first floor of the latter were badly shattered, faring, on the whole, worse than any other large group of columns in the plant.

It is now possible to report, as the repairs are nearing completion, that the ear-

liest estimate of Mr. Edison's advisers was correct. Final figures are not yet available, but it is certain that the structural repairs will not cost over 12½ per cent of the original cost, and will likely be very close to 10 per cent, making the salvage 90 per cent of the value of the concrete frames.

RECONSTRUCTION

As has been mentioned in this journal before (Jan. 9, 1915, page 40), the work of reconstruction was started as soon as plans could be made and materials ordered. Cleaning up was begun the day after the fire. In less than two weeks steel sash with wire glass was being set in Buildings 24 and 25, the former the phonograph record factory, the latter the office building. Within a month repairs on 25 were completed. Except for the three upper floors of the west wing Building 24 was finished by the

end of January. Since then this wing has been entirely restored. Repairs on Buildings 11, 13 and 15 are now practically completed, and the replacement of the collapsed section of 11 is well under way. Building 7, the last of the damaged structures to be taken in hand, will not be ready for occupancy for another month. In this structure it was found advisable to cut out about half of the slabs on two floors and rebuild them entirely. Columns, walls and, in many cases, the beams and girders were retained in the sections being rebuilt. Meanwhile, three temporary buildings with corrugated iron sheeting have been constructed in the center of the plant area.

As has been intimated above, fire-resistant construction is being used at window-openings, in the form of steel sash, set with wire glass, while all doors are metal covered. Where not already used stair and elevator wells are being enclosed with brick



DAMAGED COLUMNS AND BEAMS, SUPPLIED WITH NEW WRAPPINGS, ARE READY FOR CONCRETING

fire walls, and similar construction is being used to cut off stair and elevator towers from the structures proper.

COST OF REPAIRS

The figures kept during reconstruction show that the cost of repairing Building 25 was 2 per cent of the original cost of the frame; of Building 24, 15 per cent; of Buildings 11, 13 and 15 (a group considered as one), 10 per cent. Figures are not yet available on Building 7. Taken as a whole the repair cost will average 10 per cent of the original cost of the concrete frames.

As has been described in brief articles in this journal on Jan. 9, page 40, and Jan. 16, page 72, loose concrete was removed from beams, girders and columns, reinforcement provided (as shown in drawings herewith) and the members restored with an enlarged section. The beam section has been previously published, while the method of reinforcing girders, of restoring girders badly shattered and of strengthening the members under the heavy molding presses in Building 24 have not heretofore been printed.

While the term reinforcement is used in the paragraph above in connection with the steel, it will be seen from the accompanying drawings that in the beam repairs no additional strength can be counted on. In other words, the added concrete is in the nature of fire protection only, while the angles and wire cloth serve only to hold the concrete. That this determination not to reinforce the beams (except in the unusual cases here specifically recited) was justified is apparent, not only from inspection of the structures, but also from load tests made after the fire. In Building 11, a test of two adjoining 15 x 17½-ft. panels under a load of 300 lb. per square foot showed a maximum deflection of only 13/64 in., while two similar panels in Building 13, loaded to 400 lb. per square foot, showed a maximum deflection of only 1/8 in. These floors were originally designed for a load of 200 lb. per square foot, with allowed stresses of 16,000 lb. in the steel, 500 lb. in the concrete in compression and 75 lb. in the concrete in shear.

Contrasted with these test loads is one made on a repaired section of Building 13. Two panels of the same dimensions as those

above were loaded to 400 lb. to the square foot. The resulting maximum deflection was 5/32 in.

Where girders were badly injured it was deemed advisable to strengthen them. In some cases this was done for the full length; in others, only through the section where the bending moment was large. Angles were placed in the tension as well as in the compression flange, bolts passing up through them and through the floor slab above. The details are shown in an accompanying drawing.

Under the heavy molding presses in the fourth story of Building 24, the beams deflected a maximum of about 1½ in. It was therefore deemed advisable to add steel members of sufficient section to carry the load. Accordingly steel channels were bolted to the beams, while I-beams were placed beneath the concrete girders, carrying their loads through hangers to the concrete adjacent to the columns. These details also are shown in accompanying drawings, while photographic illustrations show the progress of the work and final appearance.

In the buildings suffering most damage, Nos. 24, 11, 13 and 15, about 23½ per cent of the beams and girders were repaired, this figure including the reinforced members under the presses in No. 24, but

excluding those in the collapsed section of No. 11.

RESTORING COLUMNS

In restoring the columns the damaged concrete was chipped away, buckled rods cut off and new vertical reinforcement and a spiral wrapping of ¼-in. rod provided. The restored columns are of circular section instead of square. Contrary to the practice in the restoration of the floor system, where the additional material is mainly for fireproofing purposes, the column renewals contemplate the strengthening of the members. The reinforcement naturally varied with the loads and spans, but for Buildings 11, 13 and 15 is shown in Table 1.

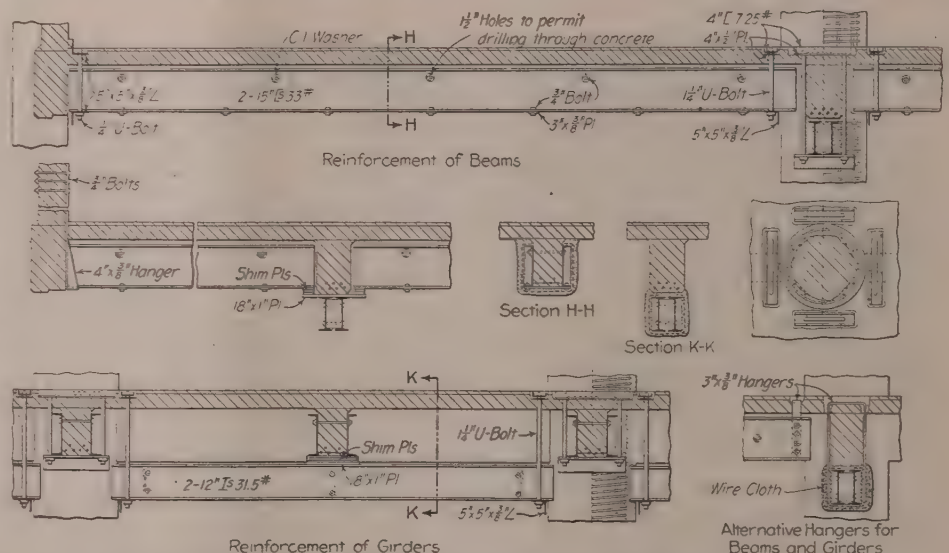
TABLE 1—REINFORCEMENT FOR RESTORED INTERIOR COLUMNS IN BUILDINGS 11, 13, AND 15

Story	Spiral		Vertical Steel
	Size, In.	Pitch, In.	
1	5/16	1½	Eight ¾ in.
2	5/16	1½	Eight ¾ in.
3	5/16	2	Eight ¾ in.
4	5/16	2	Eight ¾ in.
5	5/16	3	Four ¾ in.

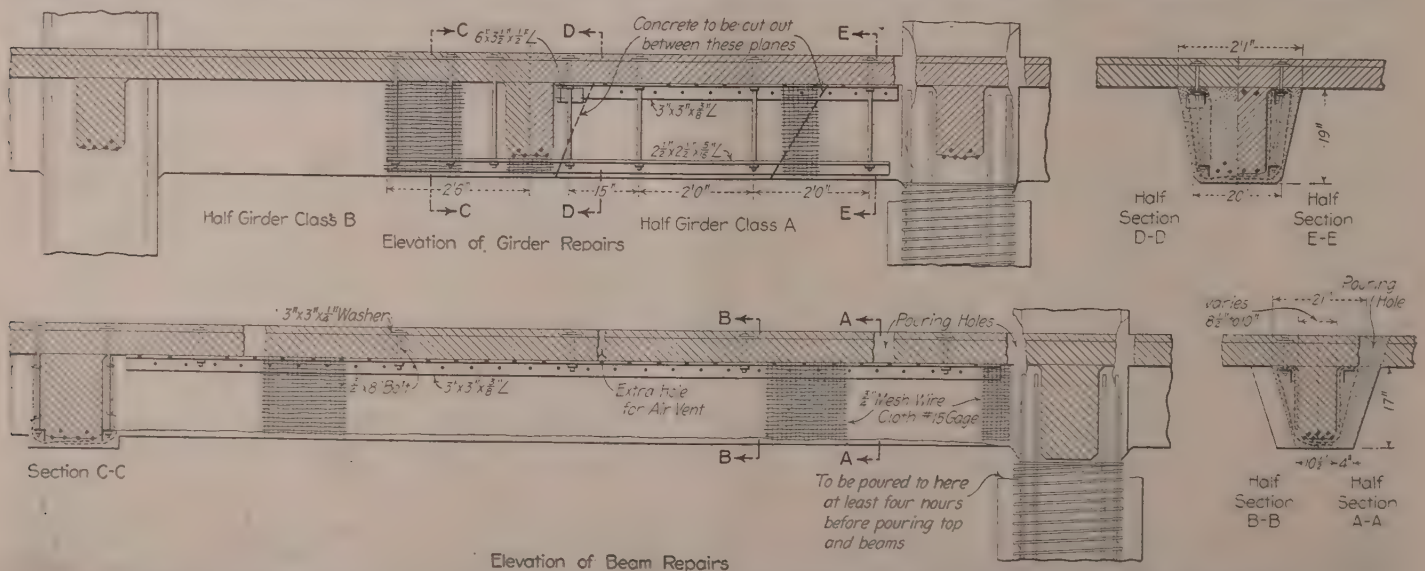
Note—Both spiral and vertical steel is round.

Where the columns had failed, they were cut out and replaced by entirely new columns.

Of the total number of concrete columns



BEAM AND GIRDER REINFORCEMENT WAS NECESSARY UNDER PRESSES IN BUILDING 24



REPAIRS ARE MADE WITH AID OF WRAPPING OF WIRE CLOTH; ADDITIONAL TENSION STEEL IS PROVIDED FOR GIRDERS

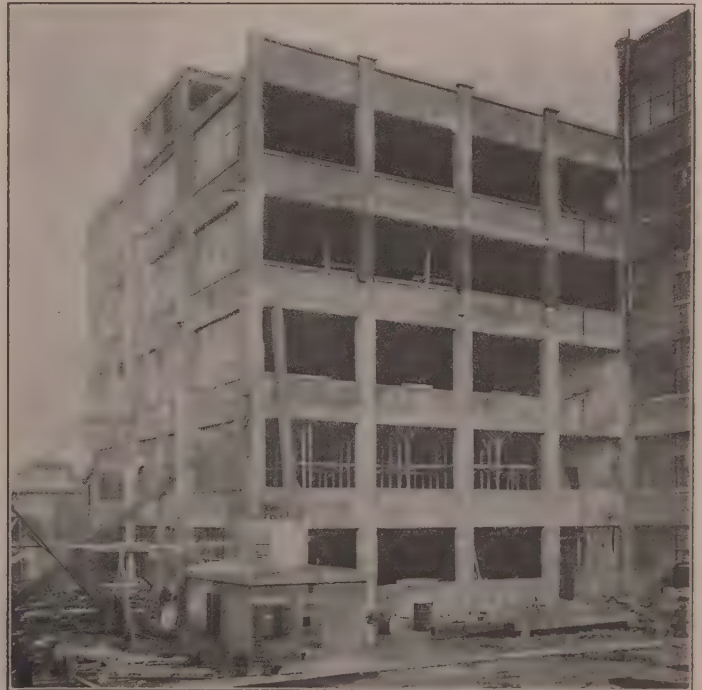
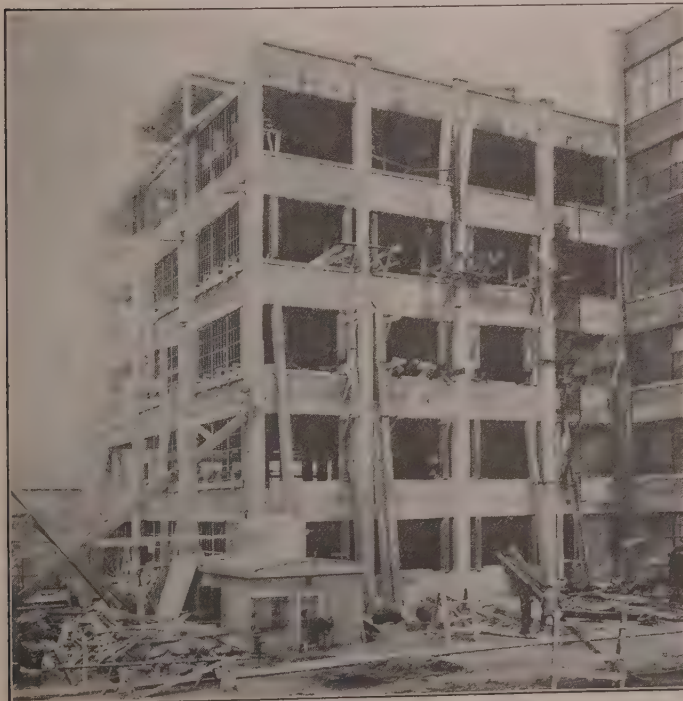
Old concrete shown cross-hatched; new concrete, stippled. Class B repairs are used on girders weakened only through section of large bending moment; Class A repairs, where entire girder is damaged. Close punching of angles secures better bond with new concrete and allows bolts, inserted, to miss slab reinforcing



FIRST FLOOR OF BUILDING 11 OF THE EDISON PLANT BEFORE AND AFTER THE WORK OF RESTORATION



A STUDY IN CONTRASTS: BUILDING 24 WHEN RESTORATION WAS BEGUN; BUILDING 25 LESS THAN A MONTH AFTER BEING GUTTED



DAMAGE TO EXTERIOR COLUMNS IN WEST WING OF BUILDING 24 OF EDISON PLANT BEING REPAIRED

in Buildings 24, 11, 13 and 15, 43.8 per cent were repaired or restored. Of the total number, however, only 2.8 per cent had to be cut out and completely replaced. On 41 per cent only repairs were made. The column repairs in No. 25 were very low.

REPORTED FUSION OF CONCRETE

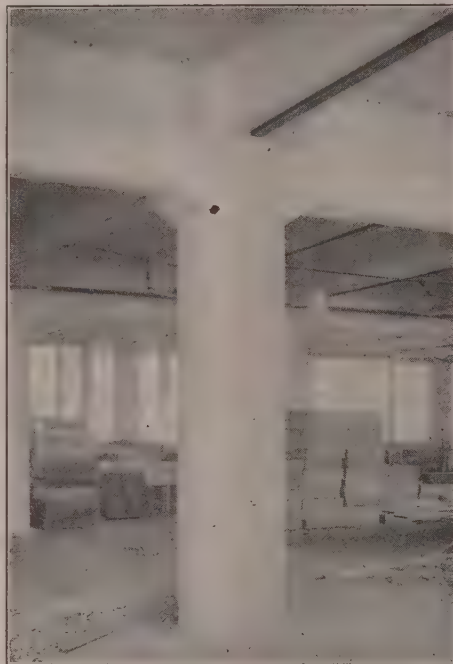
It has been reported that concrete actually fused in the fire. This report was investigated by this journal immediately after it was made, resulting in the conclusion printed in this journal of Feb. 6, page 134, that the action was that of fluxing, due to the attack upon the concrete of strong chemicals rendered all the more active by high heat. Through records and the testimony of men in charge of departments concerned it has been determined that there were stored in the basement of the structure when the slagging occurred 20 tons of ortho-cresol, 10 tons of meta-para-cresol, 35 tons of phenol, 8 tons of crude phenol (cresylic acid), and 3 tons of formaldehyde.

During reconstruction one case of actual fusion was discovered, but in the aggregate—trap rock—and not in the cement matrix. This was found in one panel of the ceiling of the third story, west wing, of Building 24, where between 20 and 40 tons of wax was stored. Testimony shows that the fire here burned fiercely for a short time, evidently until the wax was consumed, and it was undoubtedly during this time that the surfaces of the pieces of trap rock were fused. The joint report of the National Board of Fire Underwriters and the National Fire Protection Association states the temperatures in the fire reached 2500 deg. Fahr. and probably more. Undoubtedly, therefore, the concrete in these structures was subjected to a much more severe test than is generally expected of building materials. This is further borne out by the comparatively slight damage to the office building, No. 25, which contained no chemicals, wax or celluloid, the chief materials contributing to the high temperatures

elsewhere in the plant. Building 25, too, it should be remembered, was completely gutted, only the basement and one end of the first floor being practically untouched.

METHOD OF MAKING REPAIRS

It was originally proposed to repair the concrete members with the cement gun. Progress with it, however, was too slow, in the opinion of the plant authorities, and the appearance of the girders so unsatisfactory that it was decided to pour them. Various methods were tried, the one most satisfactory, and used for most of the work, being to cut holes through the floor slab above and pour the grout from concrete carts into beams, girders and columns below. The location of the holes is shown in



RESTORED COLUMN AND REINFORCED BEAMS AND GIRDERS UNDER PRESSES, BUILDING 24

accompanying illustrations. In order to insure the complete filling of the beam and girder moulds they were tapped constantly while pouring was in progress.

Where settlement had resulted on account of column failure the beams were posted and the floor jacked up to proper level. The maximum deflection was 14 in., occurring in the third story (beams of the fourth floor) of the west wing of Building 24. In this wing, also, the failure of four wall columns left the superstructure, two stories high, unsupported over a span of 75 ft., the load being carried by arch and cantilever action to the columns at the ends of the span and to the interior supports. In Building 11, similarly, there was an unsupported span on the wall line of 75 ft., but the superstructure here was four stories high. The deflection was not measured, but the shorers reported that it was negligible, amounting to but a small fraction of an inch.

The mixture was a 1:3 grout, mixed in a $\frac{3}{4}$ -yd. Ransome mixer. The grout was discharged into a bucket, hoisted to the proper floor and then distributed in concrete carts. The highest pouring record was forty-one beams and forty columns in 5 hours. The carpenter gang, for erecting and removing forms, was composed of thirty men, while twenty-five men were employed in the concrete gang, tending the mixer, carting the grout and pouring.

The method of repair was suggested by T. L. Condron, of Chicago, consulting engineer, and was carried out by H. I. Moyer, of Brooklyn, who developed some of the details and also the methods of handling the work.

THE SLAG for the comparative test of slag and trap-rock concrete made recently at Columbia University and reported in the Engineering Record of March 27, page 405, was furnished by the National Slag Company, of New York City. By a typographical error "slab" was used instead of "slag."



RESTORATION, IN RIGHT-HAND VIEW, OF INTERIOR COLUMN SHOWN SHATTERED IN EXACT CENTER OF LEFT-HAND VIEW

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Repair Wood-Stave Pipes Damaged by Earth Slide

Diver Will Disconnect Penstock at Cedar Falls Dam of Seattle's Municipal Hydro-electric Plant

Repairs are in progress on the 49 and 68-in. wood-stave penstock lines of Seattle's municipal hydroelectric plant which broke during a flood



SEATTLE'S TWIN PENSTOCKS WHICH FLOOD-LOOSENED SLIDE RUPTURED, CAUSING SHUT-DOWN AT MUNICIPAL HYDROELECTRIC PLANT

on April 5, as announced in the Engineering Record last week. Pending the completion of this work electric current for the city's street lighting system and for 38,000 private customers is being supplied by the new municipal steam plant and the Lake Union hydro auxiliary, using the overflow of the city water-works system.

From J. D. Ross, superintendent of the Seattle lighting department the following information regarding the accident has been received:

The two wood-stave pipes connect the old dam at Cedar Lake to the power plant, $3\frac{1}{2}$ miles distant and 600 ft. lower in elevation. The lower part of the pipes connect the steel penstocks at the plant. The new masonry dam, costing \$1,500,000, has been erected between the old dam and the power plant and the pipe lines run through the structure as steel tubes.

The recent flood produced by the heavy rains overtopped the crest of the old dam and filled up the impounding reservoir back of the new dam to a considerable height, entirely submerging the wood-stave pipes for a distance of $1\frac{1}{2}$ miles. The softening of the earth about the pipes caused a slide about 1000 ft. above the dam at a point where the pipes were about 25 ft. under water. The slide broke both pipes sufficiently to allow considerable rock and gravel to enter the pipes and cause a general break-down.

The department will supply the current mostly from steam until the pipes are cleared of all rubbish. A diver will disconnect the larger pipe at the front of the dam, making a new intake. Preparations for this work were made while the basin was dry, and one day will be all that will be necessary for making this change.

Society for Testing Materials to Amend By-Laws

To provide against the annual deficit due to the fact that the cost of its publications has been more than the sums received in dues, the executive committee of the American Society for Testing Materials has decided to recommend that the age limit for junior members be reduced from 30 to 25 years and that

Unriveted Steelwork Collapses in Toledo Gale

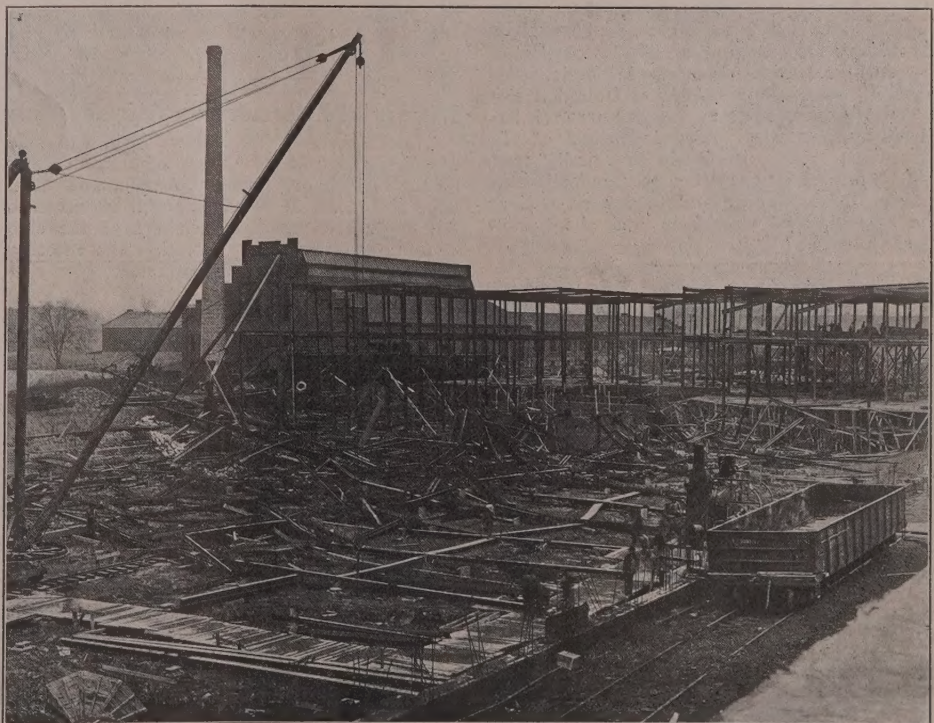
Portion of New Three-Story Building for Willys-Overland Company Falls But Riveted Section Remains Standing

During a heavy gale on the morning of April 10 an unriveted section of the steel framework, which was being erected for building 75 of the Willys-Overland Company, at Toledo, Ohio, collapsed, killing one laborer and injuring several others. The building is 200 x 1010 ft. in plan and three stories in height, with a series of light courts 40 ft. wide on the longitudinal center line.

Type of Construction

The second floor and roof are supported by steel framing, the columns of which extend from footings below the ground floor to the roof without splices. Longitudinal steel girders between columns support wood joists at the second floor and roof. Steel beams connect the columns transversely and serve to tie and brace the frame. The first floor, of the flat-slab type of reinforced concrete, is supported by reinforced-concrete columns built around the steel columns in the lower story. On the outside and court walls the steel columns are exposed and filled between with steel sash.

On the morning of the accident the erection had progressed about eighteen bays westward, starting at the east end, on the south half of the building. On the north half about ten bays had been erected. On the south half the riveting was ten bays behind the erection. About 9.45 a. m. the steel erection crew was driven to shelter by a heavy shower. The work erected since the starting hour, consisting of portions of two bays, was guyed with hemp lines. During the shower a heavy squall caused the collapse of the newly erected bents which fell northward, carrying with them successively one bent after another until the riveted portion was reached. Owing to the rain, but few workmen were on the building.



AFTER THE GALE AT TOLEDO—WRECKAGE OF UNRIVETED STEELWORK AT NEW BUILDING OF LARGE AUTOMOBILE MANUFACTURING PLANT

The riveted portion remained standing as did also all of that portion of the north half of the frame that had been erected. The steel work left standing was racked somewhat, but was immediately drawn back to place and plumbed up. The fallen steelwork was disconnected and cleaned away. Many members, especially the columns, required straightening. Only a small percentage were so injured as to require replacement. Erection was resumed after three days loss of time.

The controlling factor in the choice of this type of construction was the possible speed of erection. As soon as the footings are in place the steel frame can be erected in place very rapidly. Work can then progress simultaneously on all floors and the roof. At the same time the steel sash can be set and glazed and the finished floors laid.

The Willys-Overland Company in 1914 erected a building known as No. 46 of a type exactly similar to No. 75. This building is 200 x 400 ft. and the time of erection from the starting of the excavation to the delivery of the finished building was but ninety days. This building is said to have proved entirely satisfactory, and the construction has been found to have ample stiffness.

Erection Progress

The erection of the steel frame of building 75 was started about April 1 and was pushed rapidly. As soon as the frame was riveted, the second floor and roof joists were placed, as well as the centering for the concrete of the first floor. The wood sub-floor for the second floor and the wood sheathing for the roof was placed as soon as the joists set. The steel was erected by the aid of two stiff-leg derricks moved forward on steel rails. A standard gage railroad track ran along each side of the building. Steel members were delivered on cars on these tracks and were transferred to the derricks by locomotive cranes running on the same tracks as the cars. Each derrick served one-half the building or a strip 100 ft. wide. During erection the frame was guyed with steel cables and braced with occasional diagonal wood posts. Owing to the type of the design, the difficulty in staying the steel frame is reported to have been unusually great.

Merritt & Chapman Charges of Anti-Trust Violation Dismissed

Isaac E. Chapman, William L. Chapman and the Merritt & Chapman Derrick & Wrecking Company will not have to stand trial on the indictment charging criminal violation of the anti-trust law. In an opinion delivered April 13 Judge Neterer, of the United States District Court, upheld the demurrer interposed by Henry A. Wise in behalf of the Chapmans and dismissed the indictment, which charged a conspiracy to monopolize the business of lightering and towing as well as the salvaging of wrecks in and about New York Harbor.

Engineering Congress Outlines Scope of Second Volume of Transactions

The second volume of the transactions of the International Engineering Congress to be held at San Francisco, Sept. 20-25, will comprise two series of papers, one on the subject of waterways, and one on irrigation. The first subject will be treated under four general topics, and possibly with two additional ones, if authors are found in sufficient time. These will cover internal waterways, economic aspects, physical features, natural waterways, towage and propulsion.

Irrigation will be treated under eleven topics: Methods of handling irrigation enterprises, duty of water, relation between supply and demand, underground sources, stream sources, tail-water from hydroelectric plants, regulations for use, methods of charge, metering, drainage, dams in general, and recent developments in India and in the Argentine Republic. Authors, representing practice abroad

as well as in this country, have been obtained to handle these subjects.

There will be from 20 to 25 original papers in the volume. It will be illustrated with charts, diagrams and halftones, together with discussions contributed by leading American and foreign engineers.

General Gorgas May Head Typhus Relief Expedition to Servia

According to information received from apparently authentic sources, Major-General William C. Gorgas, U. S. A., will assume charge of the medical relief expedition being

Army's Surgeon-General Whose Aid Is Sought in Fight Against Servian Typhus Epidemic

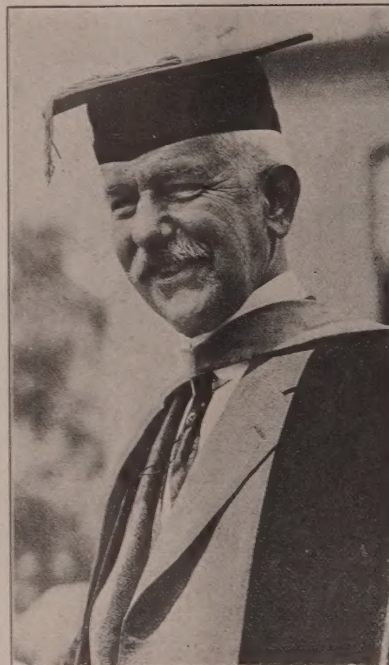


Photo Amer. Pr. Ass'n.

MAJOR-GEN. WILLIAM C. GORGAS

sent to Servia by the Rockefeller Foundation for the purpose of stamping out the epidemic of typhus fever that is raging in that country. To do this it will be necessary for him to resign his commission in the U. S. Army.

Memorial Exercises on Alfred Noble

The Engineers' Club, New York, will hold memorial exercises in honor of Alfred Noble on the evening of Thursday, April 22, at which time a portrait of Mr. Noble will be unveiled. All engineers, whether members of the club or not, are invited to attend. The meeting will be held at 32 W. 40th street.

Protest Use of Granite Between Car Tracks on Wood Paved Streets

As a result of a protest by the Kansas City Street Commission the Metropolitan Street Railway has consented not to use granite blocks between the tracks on streets paved with wood. One of the reasons advanced for the protest was that it was found that drivers uniformly forsook the granite to travel on the city's wood paving. This, it was pointed out, had a tendency to reduce the life of the city's paving, and amounted to a practical confiscation of the center of the street by the street railway for its own exclusive use. The city charter gives the city full power to determine the question irrespective of the desires of the street railway. Arbitrary measures were not necessary as the Metropolitan Company voluntarily acceded to the city's wishes.

Wing Wall Favored to Stop Reservoir Leakage

Alternative Method of Puddling Cedar River Reservoir at Seattle Is Considered Inadvisable by City Engineer Dimock

In a recent statement regarding seepage from the \$1,500,000 new masonry dam of Seattle's hydroelectric plant at Cedar Falls, A. H. Dimock, city engineer, said that in his opinion a new concrete auxiliary dam must be constructed to prevent waste of stored water. The cost of this improvement is problematical, but it will probably be between \$1,000,000 and \$1,500,000. The idea of puddling or silting the leaking storage basin back of the dam, as a means of making the porous bank hold water, has been abandoned. Instead of puddling Mr. Dimock favors the construction of a concrete wing wall, extending from the north end of the dam through the porous or glacial north bank of Cedar River, a distance of nearly 1½ miles, or to the base of the mountains, at the foot of which lies Cedar Lake.

Tests which have been made confirm the belief that even if silting will hold the water at all it can be regarded only as a temporary expedient.

Rock has been struck in three of the four test holes bored through the north bank of Cedar River, and their depth indicates that the wing wall will have a total depth of more than 200 ft. in some places reaching a depth of 225 ft. In but one of these holes has any effort been made to determine the extent of the foundation. At a point a quarter of a mile from the dam rock was struck at a depth of 198 ft., and the drill, forced into the ledge a distance of 16 ft., indicates a solid foundation. In a test hole about midway between that point and the end of the dam, rock was struck at a depth of 220 ft. and at a third test hole, about half a mile from the end of the dam, rock was struck at a depth of about 160 ft. Signs of a solid foundation have strengthened the belief that a wall is the only legitimate means of sealing the storage basin. Puddling and silting are, in Mr. Dimock's opinion, mere experiments that may be only temporary, even if found sufficient for impounding purposes.

It is believed that the cost of silting would be prohibitive as an experimental effort to seal the storage basin; for 3,000,000 cu. yd. of earth will have to be handled to carry out the plan.

"Before I make any report to the council or make a request for more funds to carry on the work," Mr. Dimock said, "I will submit an estimate of the cost of silting, as well as an estimate of the cost of an auxiliary wing wall. There will, in my opinion, be so little difference that the council would not be justified in authorizing the silting plan that can hardly be regarded as other than experimental, as against one that insures success, provided a proper foundation is found. It would be futile to build a wall unless the foundation is all that we believe it is now, from the limited borings made. However, estimates will be made of the cost of both plans, and it will then be up to the council to adopt one or the other."

Will Build Steel Setting for Mt. Wilson Telescope

The automobile road up Mt. Wilson in Southern California has been widened to facilitate handling materials for the dome of the new 100-in. Carnegie telescope, and the first of the 70 tons of steel required is now being hauled to the summit. The steel work is to be completed this summer so as to leave all of next summer for mounting the enormous telescope.

The great concave mirror which is being ground at the shops in Pasadena is the largest of its size ever constructed. It has already been subjected to three years of grinding, and is expected to be completed in another year.

Maurice A. Viele Is Dead

Maurice A. Viele, founder of the engineering firm of Viele, Blackwell & Buck, of New York City, died in New York, April 10. He obtained his professional education in Hobart College and in the Massachusetts Institute of Technology, having been graduated from the former in 1884 and from the latter in 1886. His first engineering engagement was with the Croton Aqueduct commission of New York City in the capacity of rodman. He attained the grade of assistant engineer previous to resigning from this service.

At the outbreak of the Spanish-American war he volunteered for service in a regiment of engineers and the rank of first-lieutenant was conferred on him. In this capacity he served during the Porto Rican campaign.

At the close of the war he was engaged by the General Electric Company at Schenectady and rose to the position of first vice-president of the company in 1906, when he resigned to form the firm of Viele, Blackwell & Buck, of which he was president. With this firm he was connected with some of the largest hydroelectric developments completed in this country in recent years. In addition to his connection with Viele, Blackwell & Buck he was vice-president of the Appalachian Power Company, the Northern Ontario Light & Power Company and the Northern Canada Power Company, and was a director of many public utility companies with which he had been connected in an engineering capacity.

No International Geodetic Association Meeting in 1915

The International Geodetic Association has given notice that, owing to the war in Europe, no meeting of the association will be held in 1915.

News of Engineering Societies

The Roanoke Engineering Club heard C. A. Mees, consulting and designing engineer of Charlotte, N. C., speak on "Hydroelectric Engineering" at a meeting held recently in that city. The lecture included a description of the new Lookout Shoals hydroelectric station, now being built by the Southern Power Company, and was illustrated by lantern slides.

Personal Notes

H. C. Hawkins has been appointed city engineer of Oskaloosa, Iowa.

J. P. Price has been reappointed city engineer of Columbia, Mo. He was originally appointed to this office, May, 1912.

J. Byers Holbrook, consulting engineer of New York City, has moved his offices from 3 S. William Street to 52 Vanderbilt Avenue.

E. F. Bridges, formerly city engineer of Oskaloosa, Iowa, has accepted the office of general manager of the Oskaloosa Paving Brick Company.

R. E. Harrison, assistant engineer, is temporarily in charge of the office of city engineer of Grand Rapids, Mich., pending the appointment of a successor to L. E. Stevens, resigned.

Harry B. Hangar, a member of the contracting firm of Mason & Hangar, was named as one of the Kentucky commissioners of the Dixie highway by Governor McCreary of that State.

Samuel T. Wagner, assistant engineer of the Philadelphia & Reading Railway, has been appointed chief engineer. He succeeds William Hunter, whose death was noted in this journal April 10.

Harry P. Letton, of the United States Public Health Service has been assigned to the Marine Hospital, Chicago. He will make investigations of the water used on common carriers.

Samuel M. Gray, consulting engineer of Providence, R. I., has been retained to pass on the plans for the projected sewer system of

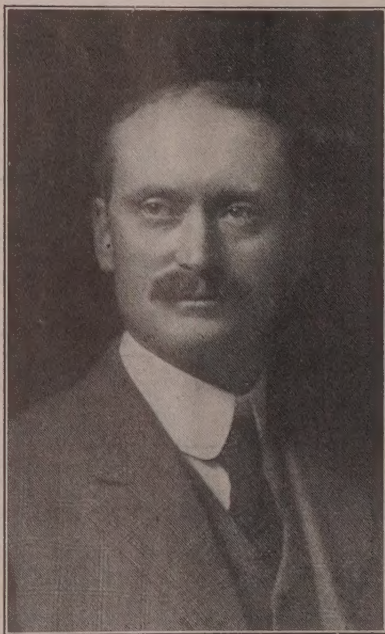
Johnstown, Pa. These plans were prepared by C. P. Collins, sanitary engineer of that city.

J. W. Burt, supervisor of track of the Cleveland, Cincinnati, Chicago & St. Louis Railway, at Springfield, Ohio, has been appointed engineer of maintenance of way of the Michigan division with headquarters at Wabash, Ind.

Robert Ferriday, engineer of maintenance of way of the Cleveland, Cincinnati, Chicago & St. Louis Railway at Indianapolis has been appointed engineer of maintenance of way of the Chicago division with headquarters at Indianapolis.

George A. Ricker, whose resignation as con-

Death Removes from the Hydroelectric Field One of Its Most Eminent Members



MAURICE A. VIELE

sulting engineer of the State highway commission was noted in these columns, April 10, is now engaged in private practice. He is located, for the time being, at 110 State St., Albany, N. Y.

R. M. Clayton, formerly city engineer of Atlanta, Ga., has opened an office in the Temple Building in that city for the purpose of practicing as consulting engineer. He will specialize in waterworks, sewer work and street paving.

Norman M. Halcombe, civil and mining engineer and senior member of the firm of Halcombe, Flanders & Read of San Francisco, is en route to London to join the Royal British Engineering Corps. Mr. Halcombe is a native of New Zealand.

Joseph Mullen, engineer of maintenance of way of the Cleveland Division of the Cleveland Cincinnati, Chicago & St. Louis railway, has been appointed assistant engineer in charge of special investigations in the office of the chief engineer at Cincinnati.

C. W. Cochran, engineer maintenance of way of the Cairo division of the Cleveland, Cincinnati, Chicago & St. Louis Railway, has been appointed engineer of maintenance of way of the Cleveland division of the same line with headquarters at Galion, Ohio.

A. F. Maischaider, engineer of maintenance of way of the Michigan division of the Cleveland, Cincinnati, Chicago & St. Louis Railway, has been appointed engineer of maintenance of way of the Cairo division of the same line, with headquarters at Mt. Carmel, Ill.

Frank W. Tuttle of the firm of Tuttle & Pike, consulting engineers and surveyors of Kansas City, has dissolved partnership with

Mr. Pike and will engage in practice, with associates, under the firm name of Tuttle, Ayers, Woodward Engineering Company, with offices in Kansas City.

Edwin S. Jarret, formerly vice-president of the Foundation Company, and Ralph H. Chambers, formerly chief engineer and general manager of the same company, have formed the Jarret-Chambers Company, Inc., to engage in business as contractors. The offices of the firm are at 30 East Forty-second Street, New York City.

J. H. Clark, who has been superintendent of floating equipment of the Baltimore & Ohio Railroad in New York harbor since 1913, has been appointed assistant-general superintendent of the New York division of the Baltimore & Ohio and general superintendent of the Staten Island lines, in addition to his present duties. His headquarters are at St. George, Staten Island, N. Y.

Chester G. Gillespie, formerly resident engineer in charge of the construction and superintendent of operation of the filtration plant at Evanston, Ill., has been appointed assistant city engineer of Sacramento, Cal. His duties will consist of a study of the possibilities in the disposal of a sewage. John Gatenby succeeds Mr. Gillespie as superintendent in charge of the operation of the Evanston plant.

A. M. Turner, district engineer of the Cleveland, Cincinnati, Chicago & St. Louis Railway, with offices at Middletown, Ohio, and Indianapolis, has been appointed engineer of maintenance of way of the Peoria & Eastern division with headquarters at Indianapolis. Mr. Turner was appointed district engineer in June, 1913, having been, previously, a resident engineer in the service of the same company.

Nathan C. Johnson has resigned as engineer of tests of the Raymond Concrete Pile Company in order to continue his investigations on the improvement of concrete and concrete materials, reported in a series of six articles published recently in the Engineering Record. Mr. Johnson expects to collaborate in this work with commercial interests prominently identified with the industry and will also open a consulting office in the near future. His present address is care of the Engineers' Club, 32 West 40th Street, New York.

D. L. Turner, deputy engineer of subway construction of the Public Service Commission, First District, of New York State, has been elected a member of the City Plan Commission of New York City. Mr. Turner was graduated from the Rensselaer Polytechnic Institute in 1891 and, after spending a year as assistant in mathematics there, was engaged by the Columbia Granite Company as an assistant engineer on railroad location and construction. In 1900 he entered the service of the New York City rapid transit commission as assistant engineer on subway construction.

William P. Taylor, formerly a division engineer in the Bureau of Highways of Philadelphia, has been appointed principal assistant engineer in the same department, succeeding W. D. Uhler, whose appointment as chief engineer of the State highway department of Pennsylvania was announced in this journal, April 10. Mr. Taylor was graduated from the University of Pennsylvania in 1900 and has served in engineering forces of the maintenance of way department of the Pennsylvania Railroad, as engineer in charge of laying a gas pipe system for Harris & Danion, of Darby, Pa., and was for some years in charge of the Philadelphia municipal testing laboratories.

John Meigs, formerly assistant director of the Department of Wharves, Docks and Ferries of Philadelphia, has been appointed director of that department. Mr. Meigs was graduated from Columbian University, Washington, D. C., in 1894, and was engaged as a draftsman by the Capital Traction Company, of Washington, and the Union Bridge Company, of Athens, Pa., until 1898, when he entered the service of the Government as junior engineer in the U. S. Engineer Office. He re-

maintained in this service until 1906, when he became engineer and superintendent in charge of construction of the Washington Channel Bridge and other similar structures in the city of Washington for the Pennsylvania Bridge Company. In 1907 he engaged in a private contracting business and in 1908 returned to the government service. In this connection he had charge of dredging operations, in the Delaware River, as principal assistant engineer stationed at Philadelphia, the annual cost of which amounted to about one million dollars.

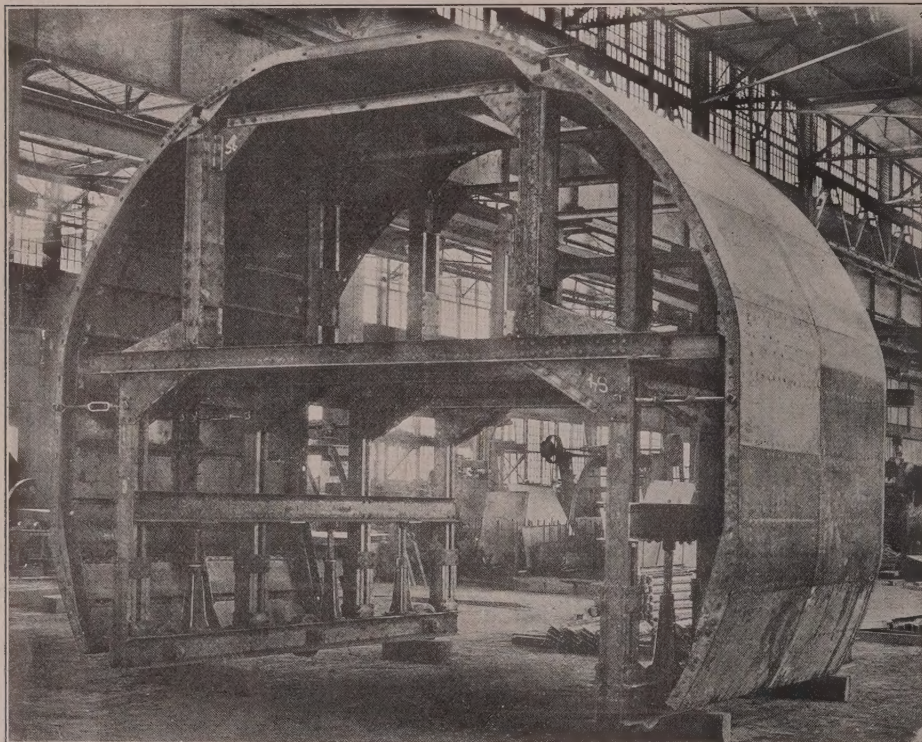
Obituary Notes

James M. Harper, of the engineering firm of Harper & Moore of Cincinnati, died in that city April 8. He was county engineer of

Steel Subway Forms Collapsed and Moved Ahead on Carriage

Steel forms, which can be collapsed and moved ahead on a special carriage through advanced forms where concrete is being poured, are to be used in constructing a subway tunnel in Boston. These forms were built for the contractor, Patrick McGovern, by the Blaw Steel Construction Company.

The photograph shows one of the forms mounted on the steel frame traveler, which will roll on rails on the finished invert. The size of the forms, 18 ft. across and 18 ft. high, and the fact that they are built to stand without interior bracing are both unusual features. After a 15-ft. section of lining has been concreted and has set, the carriage is rolled under the form, and its telescopic framework raised



CARRIAGE IN POSITION FOR COLLAPSING AND LOWERING TUNNEL FORM

Hamilton County, Ohio, from 1885 until 1891, and first assistant to the county engineer for the succeeding three years, when he resigned to engage in a private practice.

Henry W. Poor, the originator of Poor's Railway Manual, died in New York City, April 13.

E. M. Balsinger, director of the engineering department of the West Penn Traction Company of Pittsburgh, died in that city April 9.

David J. Mackey, pioneer western railroad builder and former president of the Evansville & Terre Haute Railroad, died in Evansville, Ind., April 3.

Civil Service Examinations

New York City.—Applications will be received by the Municipal Civil Service Commission until 4 p. m. April 20 for the position of engineer, bureau of sewer plan. One vacancy exists at a salary of \$4000 per year. Applicants must be citizens of the United States and residents of the State of New York.

Examinations Previously Announced

Date	See Eng. Record
April 28-29—Surveyor-draftsman, U. S. Government service; salary \$1200-\$1500....	Mar. 20
May 1—Utilities Investigator, State of Illinois; salary \$100 to \$150 per month..	April 3

by the jacks shown in the picture until it bears against the top section. The turnbuckles are meanwhile attached to the side sections and used to pull them in from the concrete to the carriage. The hinges which allow the sides of the form to swing in are plainly shown in the photograph. As soon as this is done, the jacks are lowered until the top of the form resting on the carriage clears the under side of the forms ahead. The whole is then rolled ahead to the next advance section. The removable plates are then unbolted from the sides and top, and the framework of the form spread out and jacked up into place. These plates are 5 ft. long, and are put back just in advance of the concrete as it mounts the sides of the tunnel. The crown plate is 2½ ft. wide, and the concrete for the key will be rammed in from one end.

Business Notes

The Vulcanite Portland Cement Company has moved its New York City offices from the Flatiron Building to 8 West 40th Street.

The Franklin Contracting Company, formerly of 1 and 2 Hudson Street, New York City, has moved its offices to 52 Vanderbilt Avenue.

P. D. Van Vliet, formerly editor of the Universal Portland Cement Bulletin, has been appointed assistant publicity manager of the Universal Portland Cement Company, of Pittsburgh and Chicago.

Bruno Grosche & Company, distributors of the Carbolineum brand of wood preservative, have moved their offices from Jones Lane, New York City, to 90 Wall Street.

The Chicago Pneumatic Tool Company has moved its New York City branch office from 50 Church Street to 52 Vanderbilt Avenue. Its Boston office has been moved from 191 High Street to 185 Pleasant Avenue.

Robert F. Hall, who has been connected for several years with the sales department of the Universal Portland Cement Company, of 208 South LaSalle Street, Chicago, will succeed J. P. Beck, who has resigned, as publicity manager of that company.

The Wilson-Snyder Manufacturing Company and the Wilson-Snyder Centrifugal Pump Company, manufacturers of pumping machinery, of Pittsburgh, Pa., have opened a branch office at 52 Vanderbilt Avenue, New York City. A. H. Sherwood is in charge of this office.

J. P. Beck, formerly publicity manager of the Universal Portland Cement Company, has accepted a position with Edward A. Hagar, former president of that company, who is organizing a new cement corporation with plants throughout the country. Mr. Beck is secretary-treasurer of the Cement Products Exhibition Company and general manager of the Chicago, New York and Pittsburgh cement shows. He is also secretary of the National Conference on Concrete Road Building.

W. B. Huey and A. H. Huey have organized under the firm name of the Huey Company, with offices and plant located at 59 East Adams Street, Chicago, to make blueprints, direct blue-line, negative, and black-line prints, litho reproductions, hectograph copies and photostat reproductions. W. B. Huey, who is president of the new company, was, until recently, president of the American Blue Print Paper Company, and A. H. Huey, the secretary of the new concern, was sales manager of that company.

Trade Publications

The following companies have recently issued trade publications:

Chain Belt Company, Milwaukee, Wis. Leaflet, 6 x 9 in., 8 pages, illustrated. The 1915 Chain Belt paving mixer.

Chicago Pneumatic Tool Company, Fisher Building, Chicago. Bulletin 34-M, 6 x 9 in., 36 pages, illustrated. Steam and power driven compressors.

Otis Elevator Company, New York. Catalog, 6 x 9 in., 32 pages, illustrated. Describes hand-power elevators. Catalog, 6 x 9 in., 56 pages, illustrated. Describes gravity spiral chutes and conveyors.

Raymond Concrete Pile Company, 140 Cedar Street, New York. Folder, 3½ x 6¼ in., 4 pages. Illustrates and describes the process of placing Raymond piles.

Davidson Pipe & Supply Company, Pittsburgh. Catalog, 4¼ x 6 in., 24 pages. Contains specifications, lists of iron and steel pipe, casings, tube, couplings and nipples, showing the size, weight, price, etc.

Chalmers & Williams, Inc., Chicago Heights, Ill. Pamphlet, section T, 7 x 9 in., 16 pages, illustrated. Gyratory, Blake and Symons coarse disc crushers, and revolving screens. Pamphlet, section R, 7 x 9 in., 24 pages, illustrated. Describes Symons disc crushers.

Ingersoll-Rand Company, 11 Broadway, New York City. Booklet 3015, 6 x 9 in., 32 pages, illustrated. Describes several types of electric and gasoline motor-driven, portable air-compressors for general contracting use for hammers, riveters, rammers and drills, also manufactured by this company.

A. P. Smith Manufacturing Company, East Orange, N. J. Pamphlets, 9½ x 6 in., 4, 8 and 12 pages, illustrated. A complete line of waterworks tools and supplies, such as valve inserting machines, removable screw plugs, hydrants, indicators, post valves, tapping apparatus, cutting and calking machines, and fittings.